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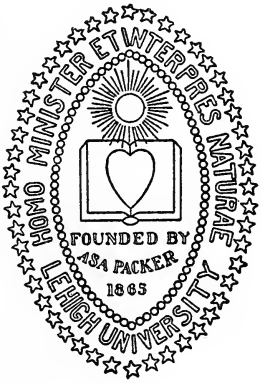
OF

LEHIGH UNIVERSITY



1918-1919

BETHLEHEM
PENNSYLVANIA

1918

JULY

S	M	T	W	T	F	S
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AUGUST

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SEPTEMBER

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OCTOBER

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DECEMBER

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1919

JANUARY

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DECEMBER

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1920

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FEBRUARY

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MARCH

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JUNE

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CALENDAR

1918	1918–1919
Sept. 6, 7, 9, 10, (Friday, Saturday, Monday, Tuesday)	Examinations for Admission.
Sept. 12, 3.30 P.M., (Thursday)	First Term begins.
Dec. 20, 6.00 P.M., (Friday)	Christmas Holidays begin.
1919	
Jan. 6, 7.45 A.M., (Monday)	Christmas Holidays end.
Feb. 20, 8.00 A.M., (Thursday)	Examinations begin.
Feb. 26, 5.00 P.M., (Wednesday)	Examinations end.
Feb. 27, 7.45 A.M., (Thursday)	Second Term begins.
Mar. 1, (Saturday)	Junior Oratorical Contest.
April 19, 12.00 M., (Saturday)	Easter Holidays begin.
April 28, 7.45 A.M., (Monday)	Easter Holidays end.
May 30, (Friday)	Memorial Day (half holiday).
June 11, 12, 13, 14, (Wednesday, Thursday, Friday, Saturday)	Examinations for Admission.
June 16, 8.00 A. M., (Monday)	Senior Examinations begin.
June 19, 8.00 A.M., (Thursday)	Other Examinations begin.
June 26, 5.00 P.M., (Thursday)	Examinations end.
June 28, (Saturday)	University Day and Alumni
June 29, (Sunday)	Baccalaureate Sunday. [Day.
June 30, (Monday)	Class Day.
June 30, (Monday)	Summer Term begins.
1919	**1919–1920**
Sept. 19, 20, 22, 23, (Friday, Saturday, Monday, Tuesday)	Examinations for Admission.
Sept. 24, 3.30 P.M., (Wednesday)	First Term begins.
Oct. 4, (Saturday)	Founder's Day.
Nov. 27, (Thursday)	Thanksgiving Holiday.
Dec. 20, 12.00 M., (Saturday)	Christmas Holidays begin.
Dec. 29, 7.45 A.M. (Monday)	Christmas Holidays end.
1920	
Jan. 23, 8.00 A. M., (Friday)	Examinations begin.
Jan. 30, 5.00 P. M., (Friday)	Examinations end.
Feb. 2, 7.45 A. M., (Monday)	Second Term begins. [bration.
Feb. 21, (Saturday)	Washington's Birthday Cele-
April 24, 12.00 M., (Saturday)	Spring Vacation begins.
May 3, 7.45 A.M., (Monday)	Spring Vacation ends.
May 24, 8.00 A.M., (Monday)	Senior Examinations begin.
May 27, 8.00 A.M., (Thursday)	Other Examinations begin.
June 3, 5.00 P.M., (Thursday)	Examinations end.
June 5, (Saturday)	University Day and Alumni
June 6, (Sunday)	Baccalaureate Sunday. [Day.
June 7, (Monday)	Class Day.
June 7, (Monday)	Summer Term begins.
June 8, 9, 10, 11, (Tuesday, Wednesday, Thursday, Friday)	Examinations for Admission.

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Lehigh University was chartered by the Legislature of Pennsylvania by act dated February 9, 1866. In 1865 the Hon. Asa Packer, of Mauch Chunk, inaugurated a movement to provide an institution that would afford training and education in the learned professions as then recognized, and in technical branches, the importance of which was then just becoming apparent in the development of the industrial and transportation interests of the country. He made an initial donation of $500,000 and a large tract of land for this purpose, to which he added largely during his lifetime and by his will.

Since its foundation the equipment and resources of the University have steadily increased due to the continued interest of the University's trustees, alumni and friends. The first important addition to the University's original plant was the Sayre Observatory, donated in 1876 by Robert H. Sayre, of Bethlehem. Later donations include Packer Memorial Church, 1887; Williams Hall, 1902; Drown Memorial Hall, 1907; the University Commons, 1907; the Wilbur Heating Plant and Engineering Laboratory, 1907; Taylor Hall, 1907; Sayre Park, 1909; the Coxe Mining Laboratory, 1910; the Fritz Engineering Laboratory, 1910; Taylor Gymnasium and Taylor Field, 1913.

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3. The Course in Metallurgy.
4. The Course in Mining Engineering.
5. The Course in Electrical Engineering.
6. The Course in Chemistry.
7. The Course in Chemical Engineering.
8. The Course in Ship Construction and Marine Transportation.

Courses are described in detail on pages 30 to 76.

REQUIREMENTS FOR ADMISSION

Candidates for admission to Lehigh University must be at least sixteen years of age, must present testimonials of good moral character, and must be qualified in the entrance subjects as enumerated below.

THE COLLEGE OF ARTS AND SCIENCE

Candidates for admission must present entrance requirements as follows:*

(a) Required Studies:	Units
English,	3
History,	1
Elementary Algebra, A and B,	1½
Plane Geometry,	1
Latin or German A or French A or Spanish A,	2
	8½

(b) Candidates must present besides the subjects in (a), 6½ units from the following:

	Units
Advanced Algebra,	½
Solid Geometry,	½
Plane Trigonometry and Logarithms,	½
Latin,	2, 3 or 4
French,	1, 2 or 3
German,	1, 2 or 3
Spanish,	1, 2 or 3
American History,	1
Ancient History,	1
Modern History,	1
English History,	1
Physics,	1
Chemistry,	1
Zoölogy,	½ or 1
Botany,	½ or 1
Physiology and Hygiene,	½ or 1
Physiography,	½ or 1
Unassigned,	½ or 1

*A unit represents a year's study in any subject in a secondary school, constituting approximately a quarter of a full year's work. A four-year secondary school curriculum should be regarded as representing not more than sixteen units of work.

THE COLLEGE OF BUSINESS ADMINISTRATION.

(a) All candidates must present the following subjects:

	Units
English,	3
German A or French A or Spanish A,	2
History,	1
Elementary Algebra, A and B,	1½
Plane Geometry,	1
	8½

(b) Candidates must present besides the subjects in (a), 5½ units from the following:

	Units
Advanced Algebra,	½
Solid Geometry,	½
Plane Trigonometry and Logarithms,	½
Latin,	2, 3 or 4
French A or German A or Spanish A,	2
American History,	1
Ancient History,	1
Modern History,	1
English History,	1
Freehand Drawing,	½
Mechanical Drawing,	½
Physics,	1
Elementary Chemistry,	1
Zoölogy,	½ or 1
Botany,	½ or 1
Physiology and Hygiene,	½ or 1
Physiography,	½ or 1
Manual Training,	½ or 1

Candidates for admission to the College of Business Administration may present Bookkeeping, Stenography and Typewriting to count ½ or 1 unit.

Detailed information concerning these subjects is given on pages 19 to 26.

Graduates of High Schools who are unable to present German or French or Spanish as specified under (a), but who can offer four units in Latin, in keeping with the official curriculum of the High Schools of the State, may substitute the two additional units of Latin for German or French or Spanish.

THE COLLEGE OF ENGINEERING

(a) Candidates for admission to the Courses in Civil Engineering, Mechanical Engineering, Metallurgical Engineering, Mining Engineering, Electrical Engineering, Chemistry, Chemical Engineering, and Ship Construction and Marine Transportation must present the following subjects:

	Units
English,	3
German A or French A or Spanish A,	2
History,	1
Elementary Algebra, A and B,	1½
Plane Geometry,	1
Solid Geometry,	½
Plane Trigonometry and Logarithms,	½
	9½

(b) Candidates must present besides the subjects in (a), 4½ units from the following:

	Units
Advanced Algebra,	½
Latin,	2, 3 or 4
Greek,	2 or 3
German,	2 or 3
French,	2 or 3
Spanish,	2 or 3
American History,	1
Ancient History,	1
Modern History,	1
English History,	1
Freehand Drawing,	½
Mechanical Drawing,	½
Physics,	1
Elementary Chemistry,	1
Zoölogy,	½ or 1
Botany,	½ or 1
Physiology and Hygiene,	½ or 1
Physiography,	½ or 1
Manual Training,	½ or 1

Detailed information concerning these subjects is given on pages 19 to 26.

The detailed requirements in the various subjects are as follows:

ENGLISH

Preparation in English has three main objects: (a) command of correct and clear English, spoken and written; (b) ability to use the vernacular with accuracy, intelligence and appreciation; and (c) some acquaintance with the simpler English classics.

ENGLISH GRAMMAR AND COMPOSITION. The first two objects require instruction in grammar and composition. English grammar should be reviewed in the secondary school; and correct spelling and grammatical accuracy should be rigorously exacted in connection with all written work during the four years. The principles of English composition governing punctuation, the use of words, paragraphs, and the different kinds of composition, including letter writing, should be thoroughly mastered; and practice in composition, oral as well as written, should extend throughout the secondary school period. Written exercises may well comprise narration, description, and easy exposition and argument based upon the principles of elementary rhetoric, as given in any approved High School Rhetoric. It is advisable that subjects for this work be taken from the student's personal experience, general knowledge, and studies other than English, as well as from his reading in literature. Finally, special instruction in language and composition should be supported by concerted efforts of teachers in all branches to cultivate in the student the habit of using good English in his recitations and various exercises, whether oral or written, making every recitation in some degree an exercise in English.

LITERATURE. The third object is sought by means of two lists of books, headed respectively *reading* and *study;* from which may be framed a progressive course in literature covering four years. In connection with both lists, the student should be trained in reading aloud and be encouraged to commit to memory some of the more notable passages both in verse and in prose.

The books for reading and study are to be selected from the groups suggested by the Conference on Uniform Entrance Requirements in English. 3 units.

HISTORY

The requirement in History is based on the recommendation of the Committee of Seven of the American Historical Association.

ANCIENT HISTORY, with special reference to Greek and Roman History, and including also a short introductory study of the more ancient nations and the chief events of the early Middle Ages, down to the death of Charlemagne (814). 1 unit.

MEDIAEVAL AND MODERN EUROPEAN HISTORY, from the death of Charlemagne to the present time. 1 unit.

ENGLISH HISTORY, with due reference to social and political development. 1 unit.

AMERICAN HISTORY AND CIVIL GOVERNMENT, with due reference to social and political development. 1 unit.

The examinations in history will be so framed as to require comparison and the use of judgment on the pupil's part rather than the mere use of memory. The examinations will presuppose the use of good text-books, collateral reading, and practice in written work. Geographical knowledge will be tested by requiring the location of places and movements on an outline map. 1 unit.

MATHEMATICS

ELEMENTARY ALGEBRA, A (ALGEBRA TO QUADRATICS). The four fundamental operations for rational algebraic expressions. Factoring, determination of highest common factor and lowest common multiple by factoring. Fractions, including complex fractions, and ratio and proportion. Linear equations, both numerical and literal, containing one or more unknown quantities. Problems depending on linear equations. Radicals, including the extraction of the square root of polynomials and of numbers. Exponents, including the fractional and negative. 1 unit.

ELEMENTARY ALGEBRA, B (QUADRATICS AND BEYOND). Quadratic equations, both numerical and literal. Simple cases of equations with one or more unknown quantities, that can be solved by the methods of linear or quadratic equations. Problems depending on quadratic equations. The binomial theorem for positive integral exponents. The formulas for the *n*th term and the sum of the terms of arithmetic and geometric progressions, with applications. ½ unit.

ADVANCED ALGEBRA. Permutations and combinations, limited to simple cases. Complex numbers, with graphical representation of sums and differences. Determinants, chiefly of the

second, third, and fourth orders, including the use of minors and the solution of linear equations. Numerical equations of higher degree, and so much of the theory of equations, with graphical methods, as is necessary for their treatment, including Descarte's rule of signs and Horner's method, but not Sturm's functions or multiple roots. ½ unit.

PLANE GEOMETRY. The usual theorems and constructions of good text-books, including the general properties of plane rectilinear figures; the circle and the measurement of angles; similar polygons; areas; regular polygons and the measurement of the circle. The solution of numerous original exercises, including loci problems. Applications to the mensuration of lines and plane surfaces. 1 unit.

SOLID GEOMETRY. The usual theorems and constructions of good text-books, including the relations of planes and lines in space; the properties and measurements of prisms, pyramids, cylinders and cones; the sphere and the spherical triangle. The solution of numerous original exercises, including loci problems. Application to the mensuration of surfaces and solids. ½ unit.

PLANE TRIGONOMETRY. Definitions and relations of the six trigonometric functions as ratios; circular measurement of angles. Proofs of principal formulas, in particular for the sine, cosine, and tangent of the sum and the difference of two angles, of the double angle and the half angle, the product expressions for the sum or the difference of two sines or of two cosines, etc.; the transformation of trigonometric expressions by means of these formulas. Solution of trigonometric equations of a simple character. Theory and use of logarithms (without the introduction of work involving infinite series). The solution of right and oblique triangles and practical applications. Candidates must bring their logarithmic tables to the examination. ½ unit.

Candidates must have a knowledge of the metric system and be prepared to solve problems in either Algebra or Geometry involving the use of the metric system.

PHYSICS

The course of instruction in Physics should include:

(a) The study of some standard text-book, for the purpose of obtaining a connected view of the subject; (b) instruction by lecture table demonstrations, to be used mainly for illustration

of the facts and phenomena of physics; (c) individual laboratory work consisting of at least thirty experiments.

The aim of laboratory work should be to supplement the pupil's fund of concrete knowledge and to cultivate his power of accurate observation and clearness of thought and expression. The exercises should be chosen with a view to furnishing forceful illustrations of fundamental principles and their practical applications. They should be such as yield results capable of ready interpretation, obviously in conformity with theory, and free from the disguise of unintelligible units.

1 unit.

MODERN LANGUAGES

ELEMENTARY GERMAN, A. This requirement follows, in the main, the recommendations of the Committee of Twelve of the Modern Language Association. It is expected that two whole years will be given to the work.

During the first year the work should comprise:

1. Careful drill in pronunciation.

2. The memorizing and frequent repetition of easy colloquial sentences.

3. Drill upon the rudiments of grammar, that is, upon the inflection of the articles, of such nouns as belong to the language of every-day life, of adjectives, pronouns, weak verbs and the more usual strong verbs; also upon the use of the more common prepositions, the simpler uses of the modal auxiliaries and the elementary rules of syntax and word-order.

4. Abundant easy exercises, designed not only to fix in mind the forms and principles of grammar, but also to cultivate readiness in the reproduction of natural forms of expression.

5. Reading of from 75 to 100 pages of graduated texts from a reader, with constant practice in translating into German easy variations upon sentences selected from the reading lesson (the teacher giving the English), and in the reproduction from memory of sentences previously read.

During the second year the work should comprise:

1. The reading of from 150 to 200 pages of literature in the form of easy stories and plays.

2. Accompanying practice, as before, in the translation into German of easy variations upon the matter read and in the off-hand reproduction, sometimes orally and sometimes in writing, of the substance of short and easy selected passages.

3. Continued drill in the rudiments of the grammar, directed to the ends of enabling the pupil, first, to use his knowledge with facility in the formation of sentences, and secondly, to state his knowledge correctly in the technical language of grammar. 2 units.

INTERMEDIATE GERMAN, B. This work should comprise, in addition to the elementary course, the reading of about 400 pages of moderately difficult prose and poetry, with constant practice in giving, sometimes orally and sometimes in writing, paraphrases, abstracts, or reproductions from memory of selected portions of the matter read; also grammatical drill upon the less usual strong verbs, the use of articles, cases, auxiliaries of all kinds, tenses and modes (with special reference to the infinitive and the subjunctive), and likewise upon word order and word formation. 1 unit.

ELEMENTARY FRENCH, A. This requirement follows, in the main, the recommendations of the Committee of Twelve of the Modern Language Association. It is expected that two whole years will be given to the work.

During the first year the work should comprise:

1. Careful drill in pronunciation.

2. The rudiments of grammar, including the inflection of the regular and the more common irregular verbs, the plural of nouns, the inflection of adjectives, participles and pronouns; the use of personal pronouns, common adverbs, prepositions and conjunctions; the order of words in the sentence and the elementary rules of syntax.

3. Abundant easy exercises, designed not only to fix in the memory the forms and principles of grammar, but also to cultivate readiness in the reproduction of natural forms of expression.

4. The reading of from 100 to 175 pages of graduated texts, with constant practice in translating into French easy variations of the sentences read (the teacher giving the English), and in reproducing from memory sentences previously read.

5. Writing French from dictation.

During the second year the work should comprise:

1. The reading of from 250 to 400 pages of easy modern prose in the form of stories, plays, or historical or biographical sketches.

2. Constant practice, as in the previous year, in translating into French easy variations upon the texts read.

3. Frequent abstracts, sometimes oral and sometimes written, of portions of the text already read.

4. Writing French from dictation.

5. Continued drill upon the rudiments of grammar, with constant application in the construction of sentences.

6. Mastery of the forms and uses of pronouns, pronominal adjectives, of all but the rare irregular verb forms, and of the simpler uses of the conditional and subjunctive. 2 units.

INTERMEDIATE FRENCH, B. This should comprise the reading of from 400 to 600 pages of French of ordinary difficulty, a portion to be in the dramatic form; constant practice in giving French paraphrases, abstracts or reproductions from memory of selected portions of the matter read; the study of a grammar of moderate completeness; writing from dictation.
1 unit.

ELEMENTARY SPANISH, A. Two years' preparation, covering the following ground:

1. Drill in correct production of Spanish sounds.

2. The rudiments of grammar, illustrated by abundant easy exercises.

3. The reading of about 150 pages of graduated texts with constant translating into Spanish of easy variations of sentences read, the teacher giving the English.

4. Aural Drill. Practice in translating into English of Spanish words, clauses and sentences heard but not seen, the teacher giving the Spanish.

During the second year:

1. Reading of 250 to 400 pages of easy modern prose.

2. Constant practice in translating into Spanish easy variations upon the texts read.

3. Aural practice and drill in pronunciation.

4. Mastery of the form and uses of pronouns, of the subjunctive mode and of the forms of the radical changing verbs.
2 units.

INTERMEDIATE SPANISH, B. The reading of not less than 500 additional pages of Spanish prose together with the translation of at least 40 pages of simple connected English prose into Spanish. 1 unit.

LATIN

The following requirements in Latin are in accordance with the recommendations made by the American Philological Association, October, 1909.

LATIN, A and B. First and Second Year Latin. Grammar, Elementary Prose Composition. Reading of an amount not less than Cæsar, *Gallic War*, I-IV, selected by the schools from Cæsar (*Gallic War* and *Civil War*) and Nepos (*Lives*). 2 units.

LATIN, C. Third Year Latin. Reading of an amount not less than Cicero, *Orations against Catiline*, *For the Manilian Law*, and *For Archias*, selected by the schools from Cicero (*Orations*, *Letters* and *De Senectute*) and Sallust (*Catiline* and *Jugurthine War*). 1 unit.

LATIN, D. Fourth Year Latin. Reading of an amount not less than Vergil, *Aeneid*, I-IV, selected by the schools from Vergil (*Aeneid*, *Bucolics*, and *Georgics*) and Ovid (*Metamorphoses*, *Fasti*, *Tristia*, *Amores*).

GREEK

The following requirements in Greek are selected in as close accordance as is practicable with the recommendations of the American Philological Association.

GREEK. Grammar; Elementary Prose Composition, consisting principally of detached sentences to test the candidate's knowledge of grammatical constructions; Xenophon: the first four books of the *Anabasis;* the translation, at sight, of a passage from some work of Xenophon. 2 units.

GREEK. Homer's *Iliad*, I-III: The first three books of the Iliad (omitting II, 494-end), and the Homeric forms, constructions, and prosody. 1 unit.

CHEMISTRY

The requirement in Chemistry is based on the report of the Committee on Chemistry of the Science Department of the National Educational Association.

ELEMENTARY CHEMISTRY. It is recommended that the candidate's preparation in chemistry include: (a) individual laboratory work, comprising at least forty exercises; (b) instruction by lecture table demonstrations, to be used mainly as a basis for questioning upon the general principles involved in the

pupil's laboratory investigations; (c) the study of at least one standard text-book, to the end that the pupil may gain a comprehensive and connected view of the most important facts and laws of elementary chemistry. 1 unit.

Students, properly qualified, will be examined in Elementary Chemistry on the first Saturday of the term; those passing the examination will be privileged to omit Chemistry (390) and Chemical Laboratory (391), and will, instead, take Theoretical Chemistry (393) during the first term.

DRAWING

FREEHAND DRAWING. Sketching of simple geometrical figures, of objects, and from copy. At least twenty plates must be submitted. ½ unit.

MECHANICAL DRAWING. The use of instruments and the preparation of at least twenty plates, illustrating the elements of descriptive geometry or simple machine parts. ½ unit.

PHYSIOGRAPHY

PHYSIOGRAPHY. The study of a standard text-book in physical geography, that a knowledge may be gained of the essential principles, and of well selected facts illustrating those principles. Individual laboratory work, comprising at least forty exercises with notebook, is recommended. ½ or 1 unit.

BOTANY

BOTANY. An amount equal to that contained in Bergen's *Foundations of Botany* with laboratory work. ½ or 1 unit.

PHYSIOLOGY AND HYGIENE

PHYSIOLOGY AND HYGIENE. A course covering approximately what is given in such a text-book as Huxley & Youman's *Physiology and Hygiene.* ½ or 1 unit.

ZOÖLOGY

ZOOLOGY. The equivalent of Jordan, Kellog & Heath's *Animal Studies* with laboratory work. ½ or 1 unit.

MANUAL TRAINING

MANUAL TRAINING. Shop work in wood or metal in schools giving courses in manual training. ½ or 1 unit.

BOOKKEEPING, TYPEWRITING AND STENOGRAPHY

BOOKKEEPING, TYPEWRITING AND STENOGRAPHY, covering a formal course of study at school. ½ or 1 unit.

DATES OF EXAMINATIONS

Examinations for admission to the University will be held in 1919, on Wednesday, Thursday, Friday, and Saturday, June 11, 12, 13, and 14, and on Friday, Saturday, Monday, and Tuesday, September 19, 20, 22 and 23; in 1920, on June 8, 9, 10 and 11, and September 17, 18, 20 and 21.

The examinations are held in June and September in the following order:

First Day.—Geometry, 8 A.M.; Physics, Ancient History, 2 P.M.

Second Day.—Elementary Algebra, *A*, 8 A.M. to 10 A.M., Elementary Algebra, *B*, 10 A.M. to 12 M.; Trigonometry, 2 P.M.

Third Day.—Latin, 8 A.M.; German, French, Spanish, Greek, 2 P.M.

Fourth Day.—English, 8 A.M.; History, 2 P.M.

Examinations in subjects presented for elective units may be arranged by correspondence with the Registrar.

Candidates for admission wishing to obtain credit for any subject of the first term of the Freshman year should notify the Registrar before September 1.

Certificates of the College Entrance Examination Board are accepted in lieu of the entrance examinations held at the University in those subjects in which the recorded grade is C (60 per cent.) or over.

ADMISSION TO ADVANCED STANDING

Candidates for admission to advanced studies in any course are required to pass, *in addition to the entrance examinations for that course*, examinations in the work already done by the classes which they desire to enter. These examinations are held in September according to a fixed schedule, in week preceding the opening of the University. The additional subjects may be found in the schedule of studies of the different departments.

A student from another college or university is admitted without entrance examinations, provided he has covered the entrance subjects required at this University and has attended another college or university for one or more complete terms. Evidence to that effect should first be filed with the Registrar. If a student has been dropped from another college or university, he must present his record to the Committee on Stand-

ing of Students and his admission will largely depend upon the record he made in the institution from which he was dropped.

Applicants who have obtained a certificate that the entrance requirements of the University are satisfied and who desire to enter the University are advised to report personally to the Secretary of the Faculty. The Secretary of the Faculty will issue to the applicant a paper authorizing him to confer with the professors regarding the subjects for which he desires credit. It is necessary for an applicant to bring a certificate naming the subjects completed at another college, together with a copy of the catalogue or register of the college; and it is desirable for him to bring his drawings, field notes, computations and laboratory note-books for inspection, and personal certificates from his teachers showing the grades attained at the college from which he comes. In case it is inconvenient for the applicant to report in person, he may send the credentials here mentioned by mail or express to the Secretary of the Faculty, who will place them before the professors and communicate the result to the applicant. Professors may admit the student to advanced standing if satisfied with these evidences of proficiency, or they may find it necessary to give a formal examination in the subjects for which he desires credits.

Professors will note their conclusions on the paper furnished the applicant, who must return the same to the Secretary of the Faculty within the time specified on its face. If all the subjects are accepted the applicant will be admitted in full standing to the Freshman, Sophomore, or Junior Class, as the case may be. If nearly all are accepted, the candidate may be admitted with conditions, and the Secretary of the Faculty will inform him of the rules applicable to conditioned students.

Graduates of other colleges having the Bachelor's degree or its equivalent are similarly admitted to advanced standing. The length of time necessary for the completion of a course will depend entirely upon the student's attainments at entrance and his ability. Every opportunity will be given for the completion of a course in minimum time.

It is desirable that a student who anticipates taking a technical course at Lehigh University after graduation from college should so arrange his work in college as to cover as many as possible of the subjects of the Freshman and Sophomore years of the technical course he intends to enter.

ADMISSION TO GRADUATE COURSES

Students of Lehigh University who have taken their first degree, and others on presenting a diploma of an equivalent degree conferred elsewhere, are admitted to advanced studies, according to the plan to be found on page 129 under the general subject of Graduate Courses.

PREPARATORY SCHOOL CERTIFICATES

The University has no permanent arrangement with any preparatory school whereby certificates are accepted in lieu of entrance examinations.

Those who desire to enter on certificate must request their preparatory school principals to send to the Registrar as soon as the school closes in June a complete record of their preparatory school work. Blanks for this purpose will be furnished by the University.

Certificates are accepted in subjects in which records are satisfactory to the professors concerned and in which the work has been completed within reasonable time limits. In the case of applicants for admission to the College of Engineering, certificates in mathematical subjects are not accepted unless there is a satisfactory record of some regular school study of mathematics during the year preceding admission; for admission to the College of Arts and Science and the College of Business Administration, certificates in mathematical subjects are not accepted for school study more than one year old. For certificate acceptance, records in modern languages must not be more than one year old.

EXAMINATIONS AT SCHOOLS

Upon the request of school principals the June entrance examinations may be held at schools on the regularly scheduled dates. Requests for examination papers should be sent to the Registrar before June 1.

THE COLLEGE OF ARTS AND SCIENCE

COURSE LEADING TO THE DEGREE OF BACHELOR OF ARTS

The College of Arts and Science of Lehigh University presents the traditional college course, modified to meet the needs of modern life and thought. Its purpose is primarily informing and cultural; it seeks to gratify intellectual curiosity, to cultivate a love of learning, to impart the knowledge and discipline which are essential to intelligent and forceful living. It has besides certain specific uses: it is the customary way of approach to the professions of medicine, law, theology and teaching.

The entrance requirements are liberal, and such as may be met readily by graduates of Pennsylvania High Schools of the first class. A statement of them may be found on page 16.

The plan of study comprises required subjects and unassigned or elective subjects. The required and elective subjects occupy respectively about two-thirds and one-third of the course. The required studies embrace courses in the English, German and French languages and literatures (two years each), mathematics, (trigonometry and solid geometry), chemistry (elementary chemistry and qualitative analysis), economics, history, psychology, biology, geology and philosophy, subjects which may be regarded as fundamental to the nature and purpose of the course. In addition two periods of physical exercise weekly throughout the course are required.

The studies of the Freshman year are fixed in keeping, so far as circumstances permit, with the subjects which have been presented for entrance. After the Freshman year the course becomes increasingly elective, a minimum of three hours weekly of electives being allowed in the Sophomore year, six in the Junior year and ten in the Senior year. A member of the Faculty is appointed to counsel with students in the choice of their studies, and to keep before them the importance of selecting their work, not in a haphazard way, but with a definite and consecutive plan. Students are thus dealt with individually rather than in groups, and the effort is made to suit the studies of each to his qualifications and purpose.

The minimum course of study comprises fifteen scholastic hours or periods weekly. Work is assigned on the assumption that two hours are required by the average student to prepare adequately for a recitation. Students of proven ability, however, are not limited to this minimum after the Freshman year, and even in that year an entering student may increase his course in chemistry from three to four hours, if, as in the case of those who are preparing for the study of medicine, there is good reason. In general, the College aims at a reasonable amount of work well done, rather than a large amount indifferently done.

Instruction is given by lectures, by recitations, by the assignment of readings and topics for study and dissertations, and, when the subject admits of it, by practical work in field or laboratory. Field work or laboratory work accompanies courses in geology, physics, chemistry, biology, psychology and allied subjects; students in advanced mathematics use, in their study of astronomy, the telescope and other instruments of the Sayre Observatory. Practice in teaching is provided in the schools of the vicinity and in the Lehigh Evening Schools for those who expect to follow teaching. Students residing at Leonard Hall who are preparing, under the direction of the Bishop of the Episcopalian Diocese of North Eastern Pennsylvania, for the theological seminary have opportunity for practical religious work.

SCHEDULE OF STUDIES OF THE B.A. COURSE

FIRST TERM	FRESHMAN YEAR	SECOND TERM
English (3)	120, 121	English (3) 122, 125
Plane Trigonometry (3)	141	Solid Geometry (3) 140
German (3)	96 or 90	German (3) 97 or 91
or French (3)	74	or French (3) 74
Latin (3)	45	Latin (3) 46
or Ancient Lit. and History (3)	47	or Mediaeval Lit. and History 47
Greek (3)	55 or 64	Greek (3) 56 or 64
or { Chemistry (2)	390	or Chemistry (3) 395
{ Chemical Lab. (1)	392	
Gymnasium (1)	500	Gymnasium (1) 500

FIRST TERM	SOPHOMORE YEAR	SECOND TERM
English Literature (2)	123	English Literature (2) 124
English Writing (1)		English Writing (1)
Economics (3)	16	Economics (3) 17
Latin (3)	48	Latin (3) 49
or Greek (3)	57	or Greek (3) 58
or Physics (3)	327	or Physics (3) 327
German (3)	98 or 96	German (3) 99 or 97
or French (3)	75	or French (3) 75
Physical Education (1)	500	Physical Education (1) 500
Unassigned (3)+		Unassigned (3)+

FIRST TERM	JUNIOR YEAR	SECOND TERM
Psychology (3)	1	Psychology (3) 1
French (3)	70 or 74	French (3) 71 or 74
or German (3)	90 or 96	or German (3) 91 or 97
Biology (3)	292	Geology (3) 268
Physical Education (1)	500	Physical Education (1) 500
Unassigned (6)+		Unassigned (6)+

FIRST TERM	SENIOR YEAR	SECOND TERM
Philosophy (2)	7	Philosophy (2) 8
French (3)	74	French (3) 74
or German (3)	96	or German (3) 97
Physical Education (1)	500	Physical Education (1) 500
Unassigned (10)+		Unassigned (10)+

Figures in parentheses indicate number of credit hours a week.

ELECTIVE STUDIES

Many of the subjects are not restricted to the years to which they are assigned, but may be taken earlier or subsequently. But this privilege is limited by considerations of the roster, and the principle that the course of each student shall be systematic, and not haphazard.

Students are required to submit their electives to the Professor in charge of electives, for the first term on or before May 1, for the second term on or before December 15.

SOPHOMORE ELECTIVES

FIRST TERM		SECOND TERM	
Advanced Algebra (3)	143	Plane Analytic Geom. (3)	145
Mod. European History (3)	40	Mod. European History (3)	40
Elementary Mechanics (3)	320	Elementary Mechanics and Heat (3)	321
Latin (3)	48	Latin (3)	49
Greek (3)	64 or 65	Greek (3)	64 or 65
Chemical Philosophy (3)	398	Advanced Chemistry (3)	399
Economic Geography (3)	29	Economic Geography (3)	29
Physiography (3)	277	Physiography (3)	278
French (3)	70	French (3)	71
or German (3)	90	or German (3)	91
History of Education (3)	10	Scientific Method (3)	9
		Physical Measurements (1)	322

JUNIOR ELECTIVES

FIRST TERM		SECOND TERM	
U. S. History (3)	41	U. S. History (3)	41
Latin (3)	50 or 52	Latin (3)	51 or 53
Greek (3)	55, 59 or 61	Greek (3)	56, 60, or 62
French (3)	83	French (3)	84
or German (3)	100 or 98	or German (3)	100 or 99
Spanish (3)	111	Spanish (3)	111
Differential Calculus (4)	146	Solid Analytic Geometry & Integral Calculus (4)	147
Elec. & Magnetism (3)	323	Light & Sound (3)	325
Mech. & Heat Lab. (1)	324	Light, Elec. & Mag. Lab. (1)	326
Quantitative Analysis (4)	401	Quantitative Analysis (4)	403
Constitutional Law (3)	22	Constitutional Law (3)	22
English (3)	126	Comparative Anatomy (3)	293
Mineralogy (4)	266	English (3)	128
Education (3)	10 or 11	Education (3)	11
Italian (3)	116	Italian (3)	116
Economic Geography (3)	29	Economic Geography (3)	29
Business Law (2)	20	Business Law (2)	21
Labor Legislation (2)	32	Labor Legislation (2)	32
		Geological Lab. (2)	269

SENIOR ELECTIVES

FIRST TERM		SECOND TERM	
U. S. History (3)	42	U. S. History (3)	42
Latin (3)	50 or 52	Latin (3)	51 or 53
Greek (3)	57, 59 or 61	Greek (3)	58, 60 or 62
German (3)	101 or 102	German (3)	101 or 102
French (3)	84 or 86	French (3)	85 or 86
Italian (3)	117	Italian (3)	117
Spanish (3)	113	Spanish (3)	113
Organic Chemistry (5)	408	Organic Chemistry (5)	408, 409
Banking (3)	36	Banking (3)	36
Education (3)	11	Education (3)	11
Embryology (3)	294	Botany (2)	290
Bacteriology (2)	296	Physiology (2)	298
Mental Hygiene (2)	3	Advanced Bacteriology (2)	297
Finance (3)	18	Social Psychology (2)	4
International Law (3)	23	Finance (3)	19
English (3)	130 or 132	International Law (3)	23
Physics (3)	332	English (3)	131 or 134
Analytic Mechanics (2)	149	Physics (3)	332
Field Geology (3)	275	Astronomy (3)	150
Petrography (2)	276	Palaeontology (3)	272
Differential Equations (1)	148	Geology of N. A. (3)	273
Adv. Electricity & Magnetism (2)	328	Electrical Laboratory (1)	330
Electrical Laboratory (1)	329	Analytic Mechanics (3)	152

Figures in parentheses indicate number of credit hours a week.

PRE-MEDICAL COURSES

All the better grade of medical schools in the United States require for admission a high school course, such as is represented by 14 or more college entrance units, and at least two years of work in a college of liberal arts, three-fourths of the study of which are assigned to chemistry, physics, and biology; many of them extend their requirements to include a college degree. "In his preliminary and medical education the student should bear in mind that he is *laying the foundation for the rest of his life.* If he finds that additional preliminary education is needed to enter one of the better medical colleges, he should consider the time well spent, since he is all the more sure of having laid a solid foundation." (Bulletin of Council on Medical Education No. 111.)

There follow two plans of study, the first designed for those who are preparing to enter the second class of medical colleges mentioned above, the second for those who can spend but two years in preparation for a medical course. Whatever medical college a student contemplates entering, he should have in mind that no profession brings him into closer touch with humanity than that of medicine and that for its study no preparation can be too good.

SCHEDULE OF FOUR-YEAR MEDICAL COURSE

FIRST TERM	FRESHMAN YEAR	SECOND TERM	
English (3)	120, 121	English (3)	122, 125
Plane Trigonometry (3)	141	Solid Geometry (3)	140
German (3)	96 or 90	German (3)	97 or 91
or French (3)	74	or French (3)	74
Latin (3)	45	Latin (3)	46
or Ancient Lit. & History (3)	47	or Mediaeval Lit. & History (3)	47
Elementary Chemistry (2)	390	Qualitative Anal. (3)	395
Chemistry Lab. (2)	391	Stoichiometry (1)	397
FIRST TERM	SOPHOMORE YEAR	SECOND TERM	
English (3)	123, 129	English (3)	124, 133
German (3)	96 or 98	German (3)	97 or 99
or French (3)	75	or French (3)	75
Economics (3)	16	Economics (3)	17
Physics (3)	327	Physics (3)	327
Chemical Philosophy (3)	398	Advanced Chemistry (3)	399
FIRST TERM	JUNIOR YEAR	SECOND TERM	
Psychology (3)	1	Psychology (3)	1
French (3)	70	French (3)	71
or German (3)	90	or German (3)	91
Biology (3)	292	Geology (3)	268, 269
Quantitative Anal. (4)	400, 402	Comparative Anatomy (3)	293
Theoretical Physics (3)	332	Botany (3)	290
FIRST TERM	SENIOR YEAR	SECOND TERM	
Philosophy (2)	7	Philosophy (2)	8
French (3)	74	French (3)	74
or German (3)	96	or German (3)	97
Organic Chemistry (5)	408, 409	Organic Chemistry (5)	410, 411
Embryology (3)	294	Physiology (2)	298
Bacteriology (2)	296	Psychology (3)	4, 6

SCHEDULE OF TWO-YEAR PRE-MEDICAL COURSE

FIRST TERM	FIRST YEAR	SECOND TERM	
English (3)	120, 121	English (3)	122, 125
German (3)	96 or 90	German (3)	97 or 91
or French (3)	74	or French (3)	74
Plane Trigonometry (3)	141	Solid Geometry (3)	140
Physics (3)	327	Physics (3)	327
Elementary Chemistry (2)	390	Qualitative Anal. (3)	395
Chemistry Lab. (2)	391	Stoichiometry (1)	397
FIRST TERM	SECOND YEAR	SECOND TERM	
English (3)	123, 129	English (3)	124, 133
German (3)	96 or 98	German (3)	97 or 99
or French (3)	75	or French (3)	75
Chemical Philosophy (3)	398	Advanced Chemistry (3)	399
Biology (3)	292	Comparative Anatomy (3)	293
Psychology (3)	1	Botany (3)	290
Physics (2)	332		

Figures in parentheses indicate number of credit hours a week.

COURSES FOR TEACHERS

In the courses leading to the degree of Bachelor of Arts, outlined on pages 30-34, the student may, through a selection of suitable electives, equip himself to teach in the high school the subject or subjects he has selected as his specialty, whether in the field of English, of ancient or modern language, of history, of biology and chemistry, of physics and mathematics, or of physiography and related subjects. In the course in Business Administration he is permitted to substitute, during the Junior and Senior years, courses in distinctly pedagogical subjects sufficient to make a total of fifteen term hours. He may thus equip himself to teach in secondary schools the important branches of commerce and industry.

No one may teach in the public schools of any state without first securing a license from that state. In Pennsylvania, as in most states, the special examination for such a license is waived in the case of college graduates, provided they have completed a certain number of hours in distinctly pedagogical studies, and have applied for a provisional college certificate to teach. At the end of three years of successful experience in teaching the State of Pennsylvania issues a permanent college certificate. The requirement in this State for a provisional certificate calls for 200 recitation hours in such studies as psychology, history of education, school management, methods of teaching, logic and ethics. The wish is general, however, among superintendents and principals that the graduate, when he begins to teach, shall have completed a much larger amount of distinctly pedagogical study than the law now demands, and that he shall have had some experience in observation and practice teaching.

Lehigh University has endeavored to meet the wish of the school men of the State. The University Department of Education has worked out a system of giving students opportunities in observation and practice teaching. Through the courtesy and liberal spirit of Boards of Education and Superintendents of Public Schools, through the University's close association with private schools, and through the work of the Lehigh Evening School, the system of practice teaching has been made in a measure adjust-

able to the needs of students with different aims and at different stages in their development of teaching power.

The course in Education at Lehigh may be outlined as follows:

FIRST TERM		SECOND TERM	
SOPHOMORE YEAR.			
History of Education (3)	10	Scientific Method (3)	9
JUNIOR YEAR			
General Psychology (3)	1	General Psychology (3)	1
Secondary Education (3)	11	Secondary Education (3)	11
SENIOR YEAR			
Special Method (3)	12	Special Method (3)	12

Figures in parentheses indicate number of credit hours a week.

The courses in Mental Hygiene, Social Psychology and History of Philosophy also throw considerable light upon the true purposes of Education and the methods by which to secure them.

Graduates of state normal schools will, under the conditions prescribed by the State Department of Education, receive credit for equivalent studies in the field of education completed in the Normal Schools.

PREPARATION FOR ENGINEERING COURSES

If a student in the College of Arts and Science contemplates becoming a candidate for a degree in technology or engineering after completion of his B.A. course, it is recommended that he choose as electives during the third and fourth years of his B.A. course such science studies as are contained in the first and second years of the technical course which he wishes afterwards to complete. By carefully selecting electives, with the advice and guidance of the head of his department and the professor in charge of the technical course concerned, the graduate of the B.A. course may enter the technical course chosen as a Junior in full standing, and obtain his technical degree in two years of further study.

THE COLLEGE OF BUSINESS ADMINISTRATION

With the application of more scientific methods in all branches of human enterprise, comes a growing need of special preparation to enter the business world. Successful men who entered upon their careers thirty, forty, or fifty years ago can hardly realize that special training is necessary for business success, for they laid the foundation of their prosperity before the present highly specialized industrial and commercial period. Formerly it was common for a young man to enter an office or financial institution and to work his way to some directive position, but this becomes less and less possible as business becomes increasingly complicated and technical.

As efficiency is the keynote of future prosperity in American industry, the course in Business Administration is designed to train men to cope ably with problems of business life, and to inculcate into the minds of the coming industrial generation the idea that it is only by efficiency that we can hope to maintain national supremacy.

The Course in Business Administration is a "technical" course. It takes into account the fact that there is a Science of Business, with Economics as its underlying basis. The important subdivisions of the science of Economics, such as Accounting, Finance, Political Science, Transportation, Industry, Industrial Management, and the like, (see page 78) are offered under the course. A certain amount of work, which is not included under the head of Economics, is given in order to insure a well rounded development.

The Course stands in the same relation to the life and calling of the manufacturer, the merchant, and other men of business as do the law and medical schools of the universities to lawyers and physicians. It provides a systematic training in the structure and organization of modern industry and commerce, and in the general causes and criteria of prosperity and depression.

The Course is not only designed to prepare young men to enter business life, but it also offers preliminary training for the study of law, accountancy, public service and teaching.

The work of the Course covers four years and on its completion the degree of Bachelor of Science (B.S.) is conferred.

THE COURSE IN BUSINESS ADMINISTRATION

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
English (3)	120, 121	English (2)	122, 125
Spanish (3)	111 or 112	Spanish (3)	111 or 112
Industrial History (2)	43	Industrial History (2)	43
Plane Trigonometry (3)	141	Solid Geometry (3)	140
Engineering Drawing (3)	160	Engineering Drawing (2)	161
Construction (2)	162	Construction (2)	163
Science and Scientists (1)	13	Gymnasium (1)	500
Gymnasium (1)	500		

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
Physiography (3)	277	Physiography (3)	278
Accounting (3)	26	Accounting (3)	27
Constitutional Law (3)	22	Constitutional Law (3)	22
Economics (3)	16	Economics (3)	17
Economic Geography of N. and So. America (3)	29	Economic Geography of N. and So. America (3)	29
Spanish (3)	114	Spanish (3)	114
Physical Education (1)	500	Physical Education (1)	500

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Business Law (2)	20	Business Law (2)	21
U. S. History (3)	42	U. S. History (3)	42
Labor Legislation (2)	32	Labor Legislation (2)	32
R. R. Administration (3)	31	R. R. Administration (3)	31
Statistics (3)	35	Statistics (3)	35
Economic Geography of the Eastern Hemisphere (3)	30	Economic Geography of the Eastern Hemisphere (3)	30
Psychology (2)	2	Psychology (2)	2
Physical Education (1)	500	Physical Education (1)	500

SENIOR YEAR

FIRST TERM		SECOND TERM	
Finance (3)	18	Finance (3)	19
Banking and Currency (3)	36	Banking and Currency (3)	36
Investments (3)	34	Investments (3)	34
Mod. European History (3)	40	Mod. European History (3)	40
International Law (3)	23	International Law (3)	23
Industrial Management (2)	33	Industrial Management (2)	33
Physical Education (1)	500	Thesis	
		Physical Education (1)	500

Figures in parentheses indicate number of credit hours a week.

Students may, with the approval of the Faculty, substitute for some of the subjects in the Junior and Senior years, other subjects which will better suit their future aims.

Prospective teachers should in this connection study the statement concerning Courses for Teachers.

THE COLLEGE OF ENGINEERING

THE COURSE IN CIVIL ENGINEERING

The requirements for admission to the Course in Civil Engineering are given on page 18.

The purpose of this course is to give a broad education in those general and scientific subjects which form the foundation of all branches of technology and special training in those subjects comprised under the term of Civil Engineering. The aim of the department is to teach young men how to think and how to attack new problems, to impress upon them the underlying principles of engineering and to inspire them with a desire to do their best work.

During the Freshman year the time is devoted mostly to fundamental studies which give both general culture and preparation for the technical work of the following years. Mathematics, physics, modern languages and chemistry are given throughout both terms, the last named being taught by lectures and by practical manipulation in the laboratory. Students continue in the Freshman year the modern foreign language accepted for entrance. Drawing is done throughout the year and, as is the case in practically all the courses in drawing presented by the Civil Engineering Department, the drawing room exercises are supplemented by recitations.

The purpose of the course in Construction of the Freshman year is to give students a general idea of the scope of engineering. In this course are grouped the topics of masonry, foundations of bridges and buildings, types of retaining walls and dams, the history of architecture and engineering, street and highway construction, the history of bridges and the materials of construction. The work covers two terms and is carried on by recitations and lectures supplemented by standard books and engineering journals. Visits of inspection to structures are made and written reports on them are required.

Land and Topographic Surveying is given in the four weeks following the end of the Freshman year. By this arrangement the attention of students is concentrated upon a single subject, thus enabling practical field operations to be exemplified in the best possible manner. In Railroad Surveying of the Junior year both preliminary and final locations of a line are made and plans, profiles and estimates of cost are prepared. In Geodetic Survey-

ing, given in the Senior year, triangulations of a high degree of precision are executed, also determinations of azimuth and adjustments of the results are made by standard methods. A large collection of levels, transits and other surveying instruments enables the students to become familiar with instruments of the best type.

Among other required subjects is Strength of Materials, which gives the theory of beams, columns and shafts, and the methods of computing and designing them. In connection with this subject laboratory tests are made of timber, brick, iron and steel. Strength of Materials as here presented may be described as applied mechanics, that is, the application of mechanics to the design of engineering structures. The testing of materials is of great importance not only because of its effects on the student's understanding of the mechanics of engineering but because it gives him the ability to manipulate apparatus and to handle machines.

Roofs and Bridges receive attention throughout four terms. The analysis of trusses by graphic methods is given in the second term of the Sophomore year. Analytical methods of computing stresses are taken up in Roofs and Bridges of the second term of the Junior year and in Bridge Design and Bridges and Dams of the Senior year. Visits are made to bridges and to bridge shops. In the Senior year designs and working drawings are prepared by each student for both a highway and a railroad bridge. Some of these drawings are made in the same manner as in drawing rooms of bridge companies and others are general, that is, design drawings only. The theory of cantilever, draw, suspension and arch structures receives detailed attention. The design and construction of reinforced concrete are given in the second term of the Senior year in the course in Reinforced Concrete. This extended training in bridge engineering furnishes a foundation for structural steel and reinforced concrete work in practice.

Hydraulic Engineering and Sanitary Engineering are treated at length. The theory of the flow of water through orifices, weirs, pipes and channels together with the principles of hydraulic motors is given in the Junior year, the work being supplemented by testing in the hydraulic laboratory. In the Senior year subjects of water supply, water power and sewerage are discussed. The methods of collecting, purifying and distributing water are explained and compared; house drainage, the design of sewerage

systems and the disposal of sewage also receive attention. Computations for dams, standpipes, sewers and other appurtenances are made. Canal engineering, river and harbor work and land drainage receive attention. Irrigation by both water and sewage are also discussed. This training in Hydraulic and Sanitary Engineering subjects, including Sanitary Biology of the Senior year, is planned to enable a graduate to enter upon the work of city engineering. In connection with the course in hydraulics, measurements are made of the flow in the Lehigh River, the Lehigh Canal and other streams in the vicinity of Bethlehem and the data thus obtained are studied later and reports written thereon. In view of the increasing importance of water power development this work is of value and interest.

Contracts and Specifications of the second term of the Senior year is given by the Civil Engineering Department more from the engineering than from the legal viewpoint. This course, consisting of two lectures a week, gives the essential features of contracts and the form and scope of contracts and specifications as used in building engineering works.

Ship Construction and Ocean Transportation, required of Seniors in Civil Engineering, includes a brief history of ship development and treats briefly of steel design and construction, especially of the hull which is closely allied to structural design. Lectures are given concerning the planning of harbors and the design and construction of such terminal facilities as piers, dry docks and railroad facilities required at ocean terminals. Ocean trade routes, ship canals and their influence on trade routes, ocean freight rates and terminal charges are some of the phases of foreign commerce treated in this course.

A description of the Fritz Engineering Laboratory which is operated by the Civil Engineering Department is given on page 146.

The student who completes this course receives the degree of Civil Engineer (C.E.). Mature young men desiring to take special studies without being candidates for the degree will be afforded every facility in so doing. Graduates of this course may become candidates for the degree of Master of Science under the regulations stated on page 129.

THE COURSE IN CIVIL ENGINEERING

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
Advanced Algebra (3)	143	Plane Analytic Geom. (3)	145
Elementary Chemistry (2)	390	Spherical Trig. (1)	142
Chemistry Lab. (2)	391	Qualitative Analysis (3)	395
Elementary Mechanics (3)	320	Stoichiometry (1)	397
French (3)	74	Elem. Mech. & Heat (3)	321
or Spanish (3)	112	Phys. Measurements (1)	322
or German (3)	94	French (3)	74
Engineering Drawing (3)	160	or Spanish (3)	112
Construction (2)	162	or German (3)	95
Gymnasium (1)	500	Engineering Drawing (2)	161
		Construction (2)	163
		Gymnasium (1)	500

SUMMER TERM: Land and Topographic Surveying, 164.

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
Differential Calculus (4)	146	Solid Analytic Geom. & Integral Calculus (4)	147
Elec. & Magnetism (3)	323	Light & Sound (3)	325
Mech. & Heat Lab. (1)	324	Light, Elec. & Mag. Lab. (1)	326
Mineralogy (4)	266	General Geology (2)	268
English (3)	123, 125	Geological Lab. (2)	269
Economics (2)	16	English (3)	124, 133
Stereotomy (3)	165	Accounting (2)	26
Physical Education (1)	500	Astronomy (2)	150
		Graphic Statics (2)	166
		Physical Education (1)	500

SUMMER TERM: Shop Work or Engineering Construction.

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Strength of Materials (4)	167	Hydraulics (3)	171
Strength of Mat. Lab. (1)	168	Hydraulic Lab. (1)	172
Metallurgy (3)	248-250	Roofs & Bridges (3)	173
Heat Engines (3)	205	Heat Engines (3)	206
Analytic Mechanics (2)	149	Finance (2)	18
Business Law (2)	20	Railroad Surveying (4)	174
Engineering Problems (2)	170	Alternating Currents (2)	375
Dynamos and Motors (2)	354	Dynamo Lab. (1)	356
Dynamo Lab. (1)	355	Physical Education (1)	500
Physical Education (1)	500		

SUMMER TERM: Shop Work or Engineering Construction.

SENIOR YEAR

FIRST TERM		SECOND TERM	
Bridge Design (2)	175	Bridges & Dams (4)	181
Bridge Design Drawing (4)	176	Sanitary Engineering (3)	182
Hydraulic Engineering (4)	177	Reinforced Concrete (4)	183
Railroads (2)	178	Contracts & Specif. (2)	184
Geodetic Surveying (3)	179	Sanitary Biology (3)	295
or Prac. Astronomy (3)	151	Ship Construction and Ocean Transport'n (2)	185
Mill Buildings (2)	180	English (2)	136
Industrial Management (2)	33	Physical Education (1)	500
Physical Education (1)	500		

Figures in parentheses indicate number of credit hours a week.

THE COURSE IN MECHANICAL ENGINEERING

The requirements for admission to the Course in Mechanical Engineering are given on page 18.

The purpose of the course is to give a broad education in the various general and scientific subjects forming the foundation of all engineering and special training in the subjects pertaining to mechanical engineering in particular.

It is the aim of the Department to develop the capacity to think and to attack new problems, to ground young men in the fundamental principles as well as to inspire them with the desire to do good and thorough work.

The Freshman year is given to fundamental studies in preparation for the technical work of the following years and to studies of general cultural value. The former comprise Advanced Algebra, Analytic Geometry, Elementary Chemistry with laboratory exercises, Qualitative Analysis, Stoichiometry, Elementary Mechanics, Heat, laboratory work in Physical Measurements and a course of lectures on Engineering Construction. The cultural studies are English language and literature and modern languages,—French, German or Spanish. Students will continue the language accepted for entrance, but men who have successfully completed courses in that language equivalent to the required course at the University may take up the study of another modern language.

At the close of the second term of the Freshman year a four weeks' course is given in Constructive Elements of Machinery and of Electrical Apparatus, as well as general technology; this course comprises a series of shop visits for the purpose of acquainting beginners with machine parts, machine tools, the usual shop-tools and various processes of manufacture. It also covers the examination of electrical instruments and machinery and the inspection of their use and operation in electrical plants. This is regarded as a desirable preliminary to the study of physics and to the special course in electrical engineering pursued later. Students may substitute two months of practical work in the shops of an industrial establishment as may be approved by the Department.

In the Sophomore year the following courses are given: Differential Calculus, Solid Analytic Geometry, Integral Calculus,

Electricity and Magnetism, Light and Sound, Elementary Mechanics of Materials (Strength of Materials), Mechanical Drawing, Elementary Machine Design, Boilers and Steam Engines. The laboratory courses cover mechanics, heat, light, electricity and magnetism. English and modern languages taken in the Freshman year are continued and courses in Economics and Accounting are given.

A second summer term at the end of the Sophomore year provides a four weeks' course in shop-instruction (Mechanical Technology) which is principally devoted to familiarizing the students with those points in pattern making, moulding, forging, finishing, fitting and the construction and operation of machine tools with which they should be familiar as designers of machinery. For this course in Mechanical Technology students may substitute two months of practical shop work in industrial establishments as may be approved by the Department.

The courses given in the Junior year are Differential Equations, Analytic Mechanics, Strength of Materials, Machinery of Transmission, Graphic Statics of Mechanisms, Advanced Electricity and Magnetism, Mechanics of Machinery, Hydraulics, Kinematics, Metallurgy and Graphic Statics of structures. Laboratory courses are given in electricity and mechanical engineering. In addition to the technical courses named there are courses in Business Law, Finance and Banking.

At the close of the Junior year a four weeks' course in engineering laboratory is given. As this forms a part of the series of courses in mechanical engineering laboratory work a substitution of outside work is not permitted.

The courses of the Senior year are Technical Thermodynamics, Internal Combustion Engines (Gas Engines), Machine Design, a course dsignated by the general term Mechanical Engineering in which one or two of the following subjects will be taken up: plant engineering, refrigeration, aeronautics, marine engines, etc. Along electrical lines the following courses are included: Dynamos and Motors, Alternating Currents, Electrical Engineering and laboratory work. The work of the mechanical engineering laboratory is continued throughout the year. Courses in Mill Buildings, Industrial Management, and Contracts and Specifications are given.

The instruction in Machine Design begins in the first term of the Sophomore year and is continued throughout the year. There

is a thorough drill in projection drawing. In this work freehand sketches are first made and measurements taken of machine pieces; these sketches are then converted into full-sized drawings. There is then considerable practice in the interpretation of such drawings. This is followed by difficult projections and intersections and exercises in the proportioning of machine parts. Both empirical and rational formulæ are used to determine the dimensions of fastenings, bearings, rotating and sliding pieces, belt and toothed gearing, levers and connecting rods, the data being given as they would arise in practice. In the last year the Seniors undertake the calculations, estimates and working drawings involved in the design of simple but complete machines. In the case of these machines the general plan of arrangement is given to the students in the form of rough sketches, photographs or wood cuts. In the second term the Seniors are expected to make original designs for simple machinery, the object of which has been fully explained.

After the students in Mechanical Engineering have completed the general course in Physics they are given courses along electrical lines. The object is to impart a clear conception of electrical units and a working knowledge of resistance, impedance, reactance, capacity, the magnetism of iron and the magnetic circuit as used in the construction of electrical machinery. Attention is then directed to the theory and calculation of direct current dynamos, to the study of variable and alternating current phenomena and to the theory of the alternating current transformer. Practical problems are given in these subjects to show their application. The laboratory work which accompanies this special course involves tests of resistance, insulation, consumption of energy and efficiency.

The course in Engineering Laboratory begins with the handling and calibration of the instruments and appliances belonging to the experimental side of mechanical engineering. The simpler tests and experiments, along various lines, are taken up next, and there is a gradual progress toward complex operations as the complete test of a power plant or pumping station, or a full thermodynamic test of the steam engine. The course is, at present, most fully developed in the field of steam engineering, where it embraces steam calorimetry, flow of steam, the testing of steamtraps and separators; of injectors, pumps, and the steam turbine; extensive practice with the indicator, engine tests of various sorts and boiler testing.

Gas engineering, tests of gas producers, gas engines and oil engines, work with compressed air, tests of hot-air engines, of centrifugal pumps and of various incidental appliances and apparatus are given due place in the course. Time is also devoted to dynamometer work with experiments in friction and lubrication and determination of the efficiency of machines. The purpose of this course, kept in view in the equipment and arrangement of the laboratory, is to provide a system of well-selected and graded experiments which will illustrate and impress principles, develop the skill and judgment of the student and give a broad training in the idea, method and detail of this sort of work.

In the Senior year one or two trips are made to New York or Philadelphia during which visits of inspection are made to power plants, municipal works, ship yards and a variety of industrial plants located in these cities or their immediate vicinity.

Graduates of this course receive the degree of Mechanical Engineer (M.E.).

THE COURSE IN MECHANICAL ENGINEERING

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
Advanced Algebra (3)	143	Plane Analytic Geom. (3)	145
Elementary Chemistry (2)	390	Qualitative Analysis (3)	395
Chemistry Lab. (2)	391	Stoichiometry (1)	397
Elementary Mechanics (3)	320	Elem. Mech. & Heat (3)	321
French (3)	74	Phys. Measurements (1)	322
or German (3)	94	French (3)	74
or Spanish (3)	112	or German (3)	95
English (3)	120, 121	or Spanish (3)	112
Construction (2)	162	English (3)	122, 125
Gymnasium (1)	500	Construction (2)	163
		Gymnasium (1)	500

SUMMER TERM: Constructive Elements of Machinery and of Electrical Apparatus, 201, 350, or Practical Employment.

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
Differential Calculus (4)	146	Solid Analytic Geom. &	
Elec. & Magnetism (3)	323	Integral Calculus (4)	147
Mech. & Heat Lab. (1)	324	Light & Sound (3)	325
Elem. Mech. Materials (1)	169	Light, Elec. & Mag. Lab. (1)	326
Dr. & El. Mach. Des. (3)	200	Steam Engines (4)	204
Boilers (1)	203	Elem. Machine Des. (3)	202
French (3)	75	French (3)	75
or German (3)	98	or German (3)	99
or Spanish (3)	114	or Spanish (3)	114
English (2)	123	Accounting (2)	26
Economics (2)	16	Physical Education (1)	500
Physical Education (1)	500		

SUMMER TERM: Mechanical Technology, 207 or Practical Employment.

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Differential Equations (1)	148	Mech. of Machinery (3)	220
Analytic Mechanics (2)	149	Hydraulics (3)	171
Strength of Materials (4)	167	Hydraulic Lab. (1)	172
Strength of Mat. Lab. (1)	168	Metallurgy (3)	248-250
Machinery of Trans. (3)	211	Kinematics (4)	214
Graph. Statics of Mech. (2)	208	Graphic Statics (2)	166
Advanced Elec. & Mag. (2)	328	Electrical Lab. (1)	330
Electrical Lab. (1)	329	Engineering Lab. (1)	210
Engineering Lab. (2)	209	Finance (2)	18
Business Law (2)	20	Physical Education (1)	500
Physical Education (1)	500		

SUMMER TERM: Engineering Laboratory, 212.

SENIOR YEAR

FIRST TERM		SECOND TERM	
Thermodynamics (5)	213	Steam Turbines (5)	223
Gas Engines (3)	222	Mech. Engineering (3)	224
Machine Design (4)	215	Machine Design (4)	219
Dynamos & Motors (2)	354	Electrical Engineering (2)	361
Dynamo Lab. (1)	355	Alternating Currents (2)	375
Engineering Lab. (1)	216	Dynamo Lab. (1)	356
Mill Buildings (2)	180	Engineering Lab. (1)	221
Industrial Management (2)	33	Contracts & Specif. (2)	184
Physical Education (1)	500	Physical Education (1)	500

Figures in parentheses indicate number of credit hours a week.

THE COURSE IN METALLURGY

The requirements for admission to the Course in Metallurgy are given on page 18.

This course is designed to prepare the student for practice in any or all directions in the field of metallurgy, such as the extraction of metals from their ores and the working and refining of metals. The two branches of this subject formerly comprised in the separate courses of Metallurgical Engineering and Electrometallurgy have been united, so that the graduate is properly equipped in both of these directions and may properly be designated as prepared in the whole field of Metallurgy.

The basis of the course is necessarily fundamental and thorough training in Mathematics, Chemistry and Physics, followed by such advanced Chemistry as is useful to the metallurgist. These fundamental studies are not cut or restricted, but are given the full prominence which they should have in a metallurgist's education.

Collateral studies in other departments than metallurgy are liberally provided, such as Mineralogy, Blowpiping, General Geology, Geological Practice and Economic Geology in the Department of Geology; Mechanical Drawing and Ore Dressing in the Department of Mining Engineering; Advanced Electricity and Magnetism and Electrical Laboratory in the Department of Physics; Alternating Currents, Dynamos and Motors, Electric Power Transmission, Electric Engineering and Dynamo Laboratory in the Department of Electrical Engineering; Elements of Construction of Machinery, Heat Engines, comprising the study of boilers, steam engines, gas engines and internal combustion motors, and Engineering Laboratory in the Department of Mechanical Engineering; Hydraulics and Strength of Materials, with laboratory testing, in the Department of Civil Engineering.

Instruction in English composition, writing and oratory, in Economics, Business Law, and Contracts and Specifications is included in order to broaden the student's education. The study of German or French for one year is required, the student continuing that language with which he enters; if a student enters on Spanish he shall take one year of German. The one year of German or French is supplemented in the Senior year by read-

ings in Metallurgical German or French with the staff of the Department of Metallurgy.

The studies in Chemistry, which are so important to the metallurgist, include Laboratory Experiments, Qualitative and Quantitative Analysis, both gravimetric and volumetric, of the more common ores and metallurgical products, including Gas Analysis and Assaying, along with courses in Stoichiometry, Chemical Philosophy, Advanced Chemistry, Physical Chemistry and Physical Chemistry Laboratory. This instruction, together with the course in Physics and Physical Laboratory, constitutes the foundation on which the metallurgical instruction is based.

The special instruction in Metallurgy is begun by an introductory course of lectures on the history of the metals, their economic and mechanical importance, their physical and chemical properties, including statistics of their production and details of the distribution of their ores and the geographical distribution and conditions of their production. In connection with this some visits are taken to nearby metallurgical plants to make the student familiar with the appearance and general outline of metallurgical apparatus. Courses of lectures extending over a year take up in detail the principles of metallurgy in general, that is the general physical and chemical principles utilized in extracting metals from their ores, and the manner in which they are applied. This is followed by a course of lectures on the Metallurgy of Iron and Steel, and by another course in the Metallurgy of the other metals, in which each metal is discussed in detail. In order to impress these principles upon the student and to render their application familiar, he is required to solve a series of problems dealing with practical details of the metallurgical processes in an exact and quantitative manner, the data being taken from practice and the results being intended to give an insight into the most fundamental metallurgical questions. A course of lectures follows this in the principles of electrochemistry, and their application in electrometallurgy, accompanied by laboratory investigations of these principles as well as the general principles of metallurgical processes, including methods of making physical and chemical measurements which are of value to the practicing metallurgist. A course in Metallography acquaints the students with the methods of studying with the microscope and other instruments of precision, the physical properties, constitution and structure of metals and alloys. The course in Metallurgical Design is intended to cover the principles

of designing metallurgical plant and apparatus, involving fixing the sizes and shapes of various parts of metallurgical apparatus, execution of working drawings and calculation of costs. The seminary in the Senior year is intended to bring together the Heads of the Department and the students in the discussion of current metallurgical questions and problems and their theses.

In the summer vacations at the end of the Sophomore and Junior years the student is required, if arrangements can be made, to spend two months in practical work in a metallurgical establishment or such other plant as is approved by the Department.

The proximity of the works of the Bethlehem Steel Company and the kindness of its officers give opportunity for visits of inspection by the students in classes and individually, and thus afford unusual facilities for the practical study of the metallurgy of iron and steel. In connection with the metallurgical laboratory work, it is the practice to make investigations of the working efficiencies of furnaces in actual operation. Occasional visits of inspection are made to more distant works, in connection with the metallurgy of zinc, copper, lead, gold and silver.

Graduates of this course receive the degree of Metallurgical Engineer (Met.E.).

THE COURSE IN METALLURGY

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
Advanced Algebra (3)	143	Plane Analytic Geom. (3)	145
Elementary Chemistry (2)	390	Qualitative Analysis (3)	395
Chemistry Lab. (2)	391	Qual. Anal. Conf. (1)	396
Elementary Mechanics (3)	320	Stoichiometry (1)	397
German (3)	94 or 90	Elem. Mech. & Heat (3)	321
or French (3)	74	Phys. Measurements (1)	322
English (3)	120, 121	German (3)	95 or 91
Mechanical Drawing (3)	300	or French (3)	74
Gymnasium (1)	500	English (3)	122, 125
		Descriptive Geometry (2)	300
		Gymnasium (1)	500

SUMMER TERM: Constructive Elements of Machinery and of Electrical Apparatus, 201, 350.

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
Differential Calculus (4)	146	Solid Analytic Geom. &	
Quantitative Analysis (3)	401	Integral Calculus (4)	147
Quant. Anal. Conf. (1)	402	Quantitative Analysis (3)	403
Chemical Philosophy (3)	398	Quant. Anal. Conf. (1)	405
Elec. & Magnetism (3)	323	Advanced Chemistry (3)	399
Mech. & Heat Lab. (1)	324	Light & Sound (3)	325
Introductory Met. (2)	244	Light, Elec & Mag. Lab. (1)	326
Economics (2)	16	Hydraulics (3)	171
Physical Education (1)	500	English (2)	124
		Physical Education (1)	500

SUMMER TERM: Assaying, 413, Practical Employment.

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Physical Chemistry (3)	419	General Metallurgy (2)	245
Physical Chem. Lab. (1)	420	Met. of Iron & Steel (2)	246
Mineralogy (4)	266	Met. Problems (1)	247
Blowpipe Analysis (2)	267	General Geology (2)	268
Ore Dressing & Lab. (3)	302	Geological Lab. (2)	269
Adv. Elec. and Mag. (2)	328	Alternating Currents (2)	375
Electrical Lab. (1)	329	Electrical Eng. (2)	361
Dynamos & Motors (2)	354	Electrical Lab. (1)	330
Heat Engines (3)	205	Dynamo Lab. (1)	356
Physical Education (1)	500	Heat Engines (3)	206
		Physical Education (1)	500

SUMMER: Practical Employment.

SENIOR YEAR

FIRST TERM		SECOND TERM	
Strength of Materials (4)	167	Electrometallurgy (1)	254
Strength of Mat. Lab. (1)	168	Metallurgical Design (2)	258
Non-ferrous Met. (4)	251	Metallurgical Lab. (2)	256
Met. Problems (1)	252	Met. Seminary (1)	260
Metallography (2)	257	Thesis (4)	261
Electrochemistry (1)	253	Engineering Lab. (1)	218
Electrochem. Lab. (1)	255	Elec. Power Trans-	
Engineering Lab. (1)	217	mission (3)	372
Electrical Lab. (1)	331	Economic Geology (4)	271
Business Law (2)	20	Contracts & Specif. (2)	184
Met. French or Ger. (1)	259	Physical Education (1)	500
Seminary (1)	260		
Physical Education (1)	500		

Figures in parentheses indicate number of credit hours a week.

THE COURSE IN MINING ENGINEERING

The requirements for admission to the Course of Mining Engineering are given on page 18.

The object of this course is primarily to train a student for practice in the field of Mining Engineering. It is designed to give him the thorough fundamental training of an engineer and a breadth of education that will enable him readily to undertake work in the various lines of engineering which frequently present themselves to one of his profession.

The course, therefore, when completed, places the graduate in the path of a large number of opportunities. Not only will he have had sufficient practice and training to enter upon the field of mining, but he can also engage in work in which geology and metallurgy play an important part, as well as in engineering projects relating thereto.

The principal objects in view are that the student, upon graduation, may be enabled: first, to make and plot surface and mine surveys, and to map the topography and geology of a district; second, to analyze, value and treat minerals found upon a property, to report upon them and to analyze metallurgical products; third, to make drawings and designs to meet the requirements of given cases; fourth, to take a subordinate position as an engineer in connection with any of the previously indicated lines of work.

In the Freshman year the time is devoted to laying a foundation in the fundamental subjects of mathematics, physics, chemistry, English and modern languages. (The modern language pursued will be the one presented for entrance.)

The course in Drawing begins as soon as the student enters the University. He learns the use of drawing instruments, makes tracings and blue prints, drawings of machine parts of simple construction, and solves problems in Descriptive Geometry.

The summer schools in Land and Topographic Surveying and in Mine and Railroad Surveying are held at the close of the Freshman and Junior years respectively. The second of these schools is conducted partly in the mining regions; this gives practice in mine and railroad surveying and permits a study of

mining operations and mining plants, from which data are secured exemplifying class room work and facilitating the course in Mining Design of the Senior year.

The courses in Chemistry extend from the first term of the Freshman year to the summer school in Assaying at the end of the Sophomore year. Beginning with an introduction to general chemical theory and the elements, supplemented by laboratory work, the subject is continued by Qualitative and Quantitative Analysis. Chemical problems and reactions are taught in Stoichiometry. The instruction includes the analyses of common ores, fuels, gases and metallurgical products.

Courses in Economics, Accounting, Business Law, Finance, Industrial Management, Contracts and Specifications, extending over the three upper years, present to the student the several economic, commercial, administrative and legal aspects of conditions existing in the industrial world which are of particular importance to the engineering profession.

The importance of the conservation of the timber resources of the country and the preservation of woods against decay are treated in Forestry, together with the characteristics of the woods of the important timber species. The course in Biology takes up the study of living organisms, their structure, development, origin and distribution.

Mineralogy is introduced by a short course in Crystallography, in which models of crystals and mineral specimens are studied. The various means of identification are then applied to more difficult minerals, the determination of which may be assisted and effected by the work in Blowpipe Analysis.

In the courses in Geology, the student studies the forms and structures of the rock masses of the earth's crust, and the forces which modify them. A brief review of historical geology deals with the fossil life of the globe. Practice in Field Geology teaches the methods by which rock formations are accurately mapped. Economic Geology treats of the origin, mode of occurrence and distribution of the metallic and non-metallic minerals and substances of commercial value in the earth. The course in Petrography enables the student to identify the common rock-forming minerals by the use of the miscroscope, especially when the constituents are too fine-grained to be determined by the eye alone. Practice in the petrographic and geological laboratory and in the field gives the student the ability to recognize the main types of rocks.

Physiography treats of the classification of land forms and their geographical distribution, their relation to geologic structure, weather and climate, and their influence upon the economic development of countries. The course in Geology of North America discusses the geologic ages and the geographic distribution of the rocks of the continent, their structure and history, and includes studies of the great surveys that have been made. Paleontology reviews animal life of the past and involves the study and identification of fossils as a means of determining the age of rocks by the principles of stratigraphy.

The course in Heat Engines includes a practical study of boilers, steam and gas engines and steam turbines; work in the Wilbur Engineering Laboratory includes tests and calculations of efficiencies and powers under varying conditions.

Strength of Materials treats of the theories which govern the strength of all kinds of common materials used in construction. Practice is given in computing and designing beams, columns, girders, etc. Hydraulics deals with the flow of liquids through orifices, mains, pipes and channels, and with the principles of hydraulic motors; practical work in the Fritz Engineering Laboratory is a part of this course. Graphic Statics gives the student the ability to compute the forces developed in roof trusses, beams and girders by the method of graphical analysis.

The instruction in Mining Engineering is given during the Junior and Senior years, under the following subdivisions: prospecting, boring, mining or exploitation, haulage, hoisting, drainage, ventilation, lighting, first-aid, railroads, construction materials and mine administration. These subjects treat successively of the steps by which minerals are discovered and valued, the manner in which they are extracted from the earth and brought to the surface, the means by which mines are maintained in an economical condition from the viewpoint of mine owner and miner, the manner in which accidents may occur and means for guarding against them, and the treatment of injured persons.

The subject of Ore Dressing, supplemented by work in the Coxe Mining Laboratory, deals with the processes by which ores and fuels, direct from the mine, are rendered marketable. Construction Materials treats of the materials used in roads and structures in and around mines. Mine Administration discusses the methods of employing labor and of keeping accounts, mining principles and management.

The course in Oil and Gas Technology includes a study of the occurrence and distribution of petroleum and natural gas, the methods of prospecting and the means for obtaining them from the earth, including storage and transportation.

In Mining Design the student employs principles studied and observations made as the basis for designs and working drawings of parts of mining plant to fulfill given conditions.

In Metallurgy the general principles of the subject embracing fuels, furnaces and processes, are presented, followed by the metallurgy of iron and steel, copper, lead, gold, silver, zinc, tin, mercury, nickel and aluminium. Electrometallurgy familiarizes the student with the practical applications of electricity to metallurgical processes including electric-furnace practice.

Dynamos and Motors and Alternating Currents extend over the entire Senior year and embrace the study of the industrial applications of electricity which are of particular value to the mining engineer; practical work in the Dynamo Laboratory is included in these courses.

The facilities for exemplifying the work of the course are exceptional. Numerous cement mills, cement, slate and other quarries, ore and coal mines are within easy distance, and in the city are the great works of the Bethlehem Steel Company. During the Junior and Senior years all students in Mining Engineering are required to make inspection trips to the anthracite coal regions and to the metal mining districts of eastern Pennsylvania and of New Jersey and to the metallurgical works of those districts.

The Eckley B. Coxe Mining Laboratory contains the office and class rooms of the Department of Mining Engineering, the ore dressing machinery, drilling equipment, surveying instruments, and the sampling and chemical laboratories of the department.

Graduates of this course receive the degree of Engineer of Mines (E.M.).

THE COURSE IN MINING ENGINEERING

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
Advanced Algebra (3)	143	Plane Analytic Geom. (3)	145
Elementary Chemistry (2)	390	Spherical Trig. (1)	142
Chemistry Lab. (2)	391	Qualitative Analysis (3)	395
Elementary Mechanics (3)	320	Stoichiometry (1)	397
Spanish (3)	112	Elem. Mech. & Heat (3)	321
or French (3)	74	Phys. Measurements (1)	322
or German (3)	94	Spanish (3)	112
English (3)	120, 121	or French (3)	74
Mechanical Drawing (3)	300	or German (3)	95
Gymnasium (1)	500	English (3)	122, 125
		Descriptive Geom. (2)	300
		Gymnasium (1)	500

SUMMER TERM: Land and Topographic Surveying, 164.

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
Differential Calculus (4)	146	Solid Analytic Geom. &	
Quantitative Analysis (3)	401	Integral Calculus (4)	147
Quant. Anal. Conf. (1)	402	Quant. Analysis (3)	403
Elec. & Magnetism (3)	323	Quant. Anal. Conf. (1)	405
Mech. & Heat Lab. (1)	324	Light & Sound (3)	325
Mineralogy (4)	266	Light, Elec. & Mag. Lab. (1)	326
Blowpipe Analysis (2)	267	General Geology (2)	268
Economics (2)	16	Geol. Lab. &	
Physical Education (1)	500	Field Trips (3)	269
		Accounting (2)	26
		Physical Education (1)	500

SUMMER TERM: Assaying, 413.

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Mining (4)	301	Mining (4)	303
Ore Dressing & Lab. (3)	302	General Metallurgy (2)	245
Strength of Materials (4)	167	Met. of Iron & Steel (2)	246
Heat Engines (3)	205	Met. Problems (1)	247
Petrography (2)	276	Heat Engines (3)	206
Graphic Statics (2)	166	Hydraulics (3)	171
Business Law (2)	20	Hydraulic Lab. (1)	172
Physical Education (1)	500	Physiography (2)	278
		Finance (2)	18
		Physical Education (1)	500

SUMMER TERM: Mine and Railroad Surveying, 304.

SENIOR YEAR

FIRST TERM		SECOND TERM	
Mining (3)	305	Mining Design (3)	307
Economic Geology (2)	270	Economic Geology (4)	271
Non-ferrous Met. (2)	251	Electrometallurgy (1)	254
Dynamos & Motors (2)	354	Alternating Currents (2)	375
Dynamo Lab. (1)	355	Dynamo Lab. (1)	356
Field Geology (3)	275	Geology of N. Amer. (3)	273
Forestry (3)	291	or Paleontology (3)	272
or Biology (3)	292	Oil & Gas Tech. (2)	306
Industrial Management (2)	33	Contracts & Specif. (2)	184
Engineering Lab. (1)	217	Engineering Lab. (1)	218
Physical Education (1)	500	Physical Education (1)	500

Figures in parentheses indicate number of credit hours a week.

THE COURSE IN ELECTRICAL ENGINEERING

The requirements for admission to the Course in Electrical Engineering are given on page 18.

The object of this course is to give a broad education in those general and scientific subjects which underlie all the branches of engineering, and to give special training in those technical and business subjects which experience shows are most essential in the equipment of the electrical engineer. In seeking to accomplish this object chief emphasis is laid by the Department on the mastery of principles and on thoroughness in the analysis of problems. The course includes a number of special studies in civil, mechanical and metallurgical engineering, so that the graduate in Electrical Engineering is prepared not only to enter any of the branches of electrical engineering but also to deal with related problems in the other branches of engineering. The electrical engineering graduate of today finds that professional advancement often lies through commercial, managerial or executive channels. As superintendent or manager of electric light, power or railway properties he must be prepared to handle problems involving not merely material and technical details but human relations, touching workmen, capitalists, public utility commissioners, and the public. He must know something of the principles of accounting, economics, business law and industrial management. In recognition of the fact that the largest success is generally attained by men who combine with a sound engineering foundation some knowledge of law, finance and industrial affairs, a number of such business studies have been introduced into the course.

The fundamental studies are given in the early part of the course and include mathematics, physics, chemistry, English and that modern language accepted for entrance. These subjects include the more essential features of a broad education and they furnish a preparation for the more advanced scientific and technical training to follow. At the very outset the student, through the subject Construction, imbibes the spirit of engineering. He is taught its history, development, methods and scope.

Work in applied electricity, begun early in the course during the summer term at the end of the Freshman year, is continued through the Sophomore year in the study of Electric Distribution, and Dynamos and Motors (with Dynamo Laboratory). The

Junior and Senior years are devoted almost exclusively to advanced technical work.

The study of Electricity and Magnetism during the first term of the Sophomore year constitutes an introduction to the industrial applications of electricity.

The subject of Electric Distribution, begun the first term of the Sophomore year, makes immediate application of electrical theory to the calculation of lighting and power circuits, the testing of insulation resistance and similar problems. The study also includes the installation and wiring of electrical machinery, systems of electrical distribution, outside and interior wiring and the rules for wiring prescribed by the Fire Insurance Underwriters.

The study of Dynamos and Motors is begun the second term of the Sophomore year, and includes the construction, operation and control of direct current generators and motors, with numerous illustrative problems. The study of dynamo electric machinery is resumed under Electrical Design during the first term of the Senior year, under the name Alternating Current Machinery.

Special subjects in mechanical engineering are required in this course. Machine Design, begun in the first half of the Sophomore year, is continued for one year. Constructive Elements of Machinery is given in the summer term at the end of the Freshman year in conjunction with the work in Constructive Elements of Electrical Apparatus. Mechanical Technology is given in the summer term at the end of the Sophomore year. This is a course in shop instruction intended principally to familiarize the student with the processes involved in pattern-making, moulding, forging, fitting and finishing. Frequent visits of inspection are made to manufacturing establishments in the vicinity. Upon approval by the Head of the Department, students in Electrical Engineering will be permitted to substitute summer work in electrical shops or construction for either or both of the required summer schools. Following the work in Mechanical Technology, the study of Mechanics of Machinery is pursued during the second term of the Sophomore year. It deals with graphic methods of determining the forces acting at all points of a machine and with the efficiency of mechanisms. Heat Engines, given throughout the Junior year, includes the study of steam boilers, thermodynamics, steam engines and turbines, and gas engines. Engineering Laboratory is given throughout the

Senior year. It includes the calibration of engineering measuring instruments and the making of practical tests on boilers, engines, pumps and other apparatus.

Special studies in Civil Engineering are included in this course. Strength of Materials, given in the first term of the Junior year, is concerned with the theory of beams, columns and shafts, and the method of computing and designing them; the subject includes practical work in the testing laboratory. Hydraulics, including laboratory practice, given in the second term of the Junior year, treats of hydrostatics and theoretical hydraulics, the flow of water through orifices, weirs, pipes and channels, naval hydromechanics and hydraulic motors.

The study of General Metallurgy, Metallurgy of Iron and Steel and Metallurgical Problems is given during the second term of the Junior year. Lectures on Electrochemistry and Electrometallurgy are given during the Senior year.

Special studies in Electrical Engineering come after Electric Distribution, Dynamos and Motors, and Electricity and Magnetism of the Sophomore year. Advanced Theory of Electricity and Magnetism, begun in the first term of the Junior year, is devoted to the theory of electrical units and measurements, ferromagnetism, electromagnetism, the advanced theory of electrostatics and electric oscillations and waves, electron theory and electrolysis. The accompanying laboratory work is devoted to precise electrical measurements and the standardization and calibration of electrical measuring instruments. The Theory of Alternating Currents is also begun with the Junior year and is pursued up to the middle of the Senior year; this subject deals with the problems and methods of measurement which are peculiar to the modern practical applications of alternating currents and with the theory underlying the action of the important types of alternating current machinery and transmission lines. Alternating Current Machinery, given in the first term of Senior year, includes the study of the construction and operation of alternating current generators, motors, transformers and other apparatus.

The subject of Electrical Engineering, beginning in the second term of the Junior year, deals with the application of physical principles to the solution of problems relating to direct and alternating current circuits and apparatus.

Dynamo laboratory work, beginning in the second term of the Sophomore year, is continued for five terms. The use of a laboratory manual or notes is supplemented by individual direction and supervision in the laboratory. The students work individually or in pairs, and make the more important tests on direct and alternating current generators and motors, rotary converters, transformers and other electical apparatus. Written reports of all tests made, with curves plotted from the observations and discussion of results are required.

Electrical Design, begun in the first term of the Senior year, is pursued throughout the year. It includes the application of electric, magnetic and mechanical principles to the design of various types of electrical apparatus. The instruction is given by recitations, problems and drafting.

Electrical Engineering Seminary continues throughout the Senior year. The work consists of the presentation before the class of papers on assigned topics, supplementing the regular work of the class-room and of reports on thesis work. The Department reading-room is well supplied with the leading electrical periodicals, American and foreign. One of the principal objects of the Seminary work is to encourage the systematic reading of the current engineering journals. Reports on articles in the French and German technical periodicals are included as part of the work of the Seminary.

Dynamo Testing is given by lectures and problems beginning with the second term of the Junior year and continuing through the first term of the Senior year. It treats of standard and special methods of making tests on dynamo machines, transformers and other electrical apparatus. Most of the methods discussed in the lectures are exemplified by practical testing in the dynamo laboratory.

Electric Stations, given in the first term of the Senior year, takes up the location, design and equipment of stations, the selection of suitable prime movers, generators, switchboards and other apparatus. The use and operation of storage batteries, boosters and other auxiliaries receive consideration.

Electric Traction and Power Transmission are given during the second term of the Senior year. Under Electric Traction are studied the construction, equipment and operation of different types of electric railways. The recent developments in the application of electric motive power to steam railroad conditions

are discussed and the results of tests are analyzed. Practice is given in the estimating of the probable cost of building and operating an electric railway to fulfill certain specific conditions.

The subject of Electric Power Transmission deals with the various elements constituting a transmission system. It includes a study of the generating plant, the transmission line and the receiving systems. Special attention is given to the design, construction and projection of the line. Under the last three subjects are included visits of inspection to electric light and power stations and to manufacturing establishments in Bethlehem and elsewhere. Central station tests are made and reports are required.

Graduates of this course receive the degree of Electrical Engineer (E.E.).

THE COURSE IN ELECTRICAL ENGINEERING

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
Advanced Algebra (3)	143	Plane Analytic Geom. (3)	145
Elementary Chemistry (2)	390	Qualitative Analysis (3)	395
Chemistry Lab. (2)	391	Stoichiometry (1)	397
Elementary Mechanics (3)	320	Elem. Mech. & Heat (3)	321
French (3)	74	Phys. Measurements (1)	322
or German (3)	94	French (3)	74
or Spanish (3)	112	or German (3)	95
English (3)	120, 121	or Spanish (3)	112
Construction (2)	162	English (3)	122, 125
Gymnasium (1)	500	Construction (2)	163
		Gymnasium (1)	500

SUMMER TERM: Constructive Elements of Machinery and of Electrical Apparatus, 201, 350, or Electrical Shops.

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
Differential Calculus (4)	146	Solid Analytic Geom. &	
Elec. & Magnetism (3)	323	Integral Calculus (4)	147
Mech. & Heat Lab. (1)	324	Light & Sound (3)	325
Elem. Mech. Materials (1)	169	Light, Elec. & Mag. Lab. (1)	326
Elec. Distribution (2)	351	Dynamos and Motors (3)	352
Dr. & El. Mach. Des. (3)	200	Dynamo Lab. (1)	353
English (3)	123, 129	Machine Design (3)	202
Economics (2)	16	Graphic Statics of	
Physical Education (1)	500	Mech. (2)	208
		Accounting (2)	26
		Physical Education (1)	500

SUMMER TERM: Mechanical Technology, 207 or Electrical Shops.

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Advanced Elec. & Mag. (2)	328	Alternating Currents (2)	359
Analytic Mechanics (2)	149	Electrical Engineering (2)	360
Differential Equations (1)	148	Dynamo Testing (1)	364
Theory of Alt. Cur. (3)	357	Dynamo Lab. (1)	362
Dynamo Lab. (1)	358	Electrical Lab. (1)	330
Electrical Lab. (1)	329	Heat Engines (3)	206
Heat Engines (3)	205	Hydraulics (3)	171
Strength of Materials (4)	167	Hydraulic Lab. (1)	172
Strength of Mat. Lab. (1)	168	Finance (2)	18
Business Law (2)	20	Metallurgy (3)	248-250
Physical Education (1)	500	Physical Education (1)	500

SUMMER TERM: Electrical Engineering Inspection, 376; Electrical Shops.

SENIOR YEAR

FIRST TERM		SECOND TERM	
Alt. Current Mach. (4)	363	Electric Traction (3)	371
Dynamo Lab. (3)	366	Dynamo Lab. (2)	374
Dynamo Testing (1)	365	Elec. Power Trans. (3)	372
Electrical Design (3)	367	Electrical Design (2)	370
Electrical Seminary (1)	369	Electrical Seminary (1)	373
Electric Stations (2)	368	Electrometallurgy (1)	254
Electrochemistry (1)	253	Engineering Lab. (1)	218
Engineering Lab. (1)	217	Contracts & Specif. (2)	184
Industrial Management (2)	33	Thesis (3)	377
Physical Education (1)	500	or Elec. Communu. (3)	378
		Physical Education (1)	500

Figures in parentheses indicate number of credit hours a week.

THE COURSE IN CHEMISTRY

The requirements for admission to the Course in Chemistry are given on Page 18.

This course, leading to the degree of Bachelor of Science in Chemistry, offers an education primarily in Chemistry, with some training in related sciences. The modern conception of an education in Chemistry includes a simultaneous, thorough study of Physics and Mathematics. In addition to these so-called physical sciences, other studies, planned to develop and aid the thought-processes and culture of the student, are embodied in the course. Aside from preparation for the life of a professional chemist, it is well adapted for teachers of chemistry and as a course preliminary to the study of medicine.

This course and the course in Chemical Engineering are both given under the direction of the Department of Chemistry, and facility is offered for changing from either course to the other at the end of either term of the Freshmen year. The entrance subjects required are the same in both courses (see page 18), and the tuition and laboratory costs are practically the same. Subjects with the same title in the tabulated curricula (see pages 67 and 73) are given to students in both courses simultaneously and under the same teachers, and are equal in content. Details of chemistry subjects are described in the course in Chemical Engineering.

French and German receive considerably more attention in the course in Chemistry, both as language tools for the working chemist and in their cultural aspects. Students who enter the University on French will continue in that language through the Freshman year, and will take up German through the Sophomore and Junior years. Those who offer German as an entrance subject will continue in that language through the Freshman and Sophomore year and will study French through the Junior year. This division of time given to the respective language reflects the customary judgment, both as to their difficulty and their relative importance in the science of Chemistry at the present writing. Students who offer Spanish for entrance will take German through the Freshman and Sophomore years, and French through the Junior year.

Biology is placed in the Senior year and is taught in that Department of the University. It is of great value in establishing clear ideas of plant and animal organisms, their functions and interrelations, all of which are of interest to the scientist in chemistry; and, furthermore, the laws and theories of biology are of great moment in current intellectual and civic life. This subject is presented in lectures supplemented by work in the laboratory on higher and lower organisms. The course in Bacteriology of the Senior year is given in the same department.

Mineralogy receives full consideration in the first term of the Junior year, developing the physical and chemical characteristics of minerals, and their recognition in specimens. The study of crystallography is included. Geology follows in the second term of this year.

Economics throughout the Junior year and Modern European History through the Senior year are the full courses given under these headings in this University by the Department of History and Economics. The same department will supervise the Summer Reading in Economics, embracing such subjects as origins of industry and their relations to science, the economic import of inventions, industrial management, business law and custom and contracts. The topics for Summer Reading are also correlated in the lectures under the heading Economics, mentioned above. It is believed that this course of reading and study under expert guidance will inculcate an appreciation of the profit and pleasure to be derived from a continued interest in history and economics.

In order to acquaint the student with factory methods and personnel, a required summer term of work in factory or laboratory is set for the vacations following the Freshman and Junior years. Young men of exceptional ability and ambition are encouraged to enroll in subjects given in the University not listed in the Course in Chemistry, subject to Faculty rules.

The foregoing course will serve as an excellent preparation for graduate study; students who desire to go forward to the Master's Degree (M.S.) will find information on page 129 of this Register.

THE COURSE IN CHEMISTRY

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
Advanced Algebra (3)	143	Plane Analytic Geom. (3)	145
Elementary Chemistry (2)	390	Chemistry (1)	394
Chemistry Lab. (2)	391	Qualitative Analysis (3)	395
Elementary Mechanics (3)	320	Qual. Anal. Conf. (1)	396
Dr. & El. Mach. Des. (3)	200	Stoichiometry (1)	397
French (3)	74	Elem. Mech. & Heat (3)	321
or German (3)	94 or 90	Phys. Measurements (1)	322
English (3)	120, 121	French (3)	74
Gymnasium (1)	500	or German (3)	95 or 91
		English (3)	122, 125
		Gymnasium (1)	500

SUMMER TERM: Work in Industrial Shop or Laboratory. Summer Reading in Economics.

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
Differential Calculus (4)	146	Solid Analytic Geom. &	
Chemical Philosophy (3)	398	Integral Calculus (4)	147
Quantitative Analysis (3)	400	Advanced Chemistry (3)	399
Quant. Anal. Conf. (1)	402	Quantitative Analysis (4)	404
Elec. & Magnetism (3)	323	Quant. Anal. Conf. (2)	405
Mech. & Heat Lab. (1)	324	Light & Sound (3)	325
German (3)	98 or 94 or 90	Light, Elec. & Mag. Lab. (1)	326
English (3)	123, 129	German (3)	99 or 95 or 91
Physical Education (1)	500	Physical Education (1)	500

SUMMER TERM: Assaying, 413. Summer Reading in Economics.

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Quantitative Analysis (2)	406	Organic Chemistry (4)	410
Quant. Anal. Conf. (2)	407	Organic Chem. Lab. (4)	411
Organic Chemistry (3)	408	General Metallurgy (2)	245
Organic Chem. Lab. (2)	409	Met. of Iron & Steel (2)	246
Mineralogy (4)	266	Met. Problems (1)	247
Economics (3)	16	General Geology (2)	268
French (3)	70	Economics (3)	17
or German (3)	94	French (3)	71
Physical Education (1)	500	or German (3)	95
		Physical Education (1)	500

SUMMER TERM: Work in Industrial Shop or Laboratory. Summer Reading in Economics.

SENIOR YEAR

FIRST TERM		SECOND TERM	
Physical Chemistry (3)	419	Physical Chemistry (2)	421
Physical Chem. Lab. (1)	420	Physical Chem. Lab. (1)	422
Industrial Chem. Lab. (3)	412	Research Chem. Lab. (2)	423
Non-ferrous Met. (4)	251	Industrial Analysis (3)	416
Met. Problems (1)	252	Industrial Anal. Conf. (1)	417
Biology (3)	292	Sanitary Chem. Lab. (2)	418
Bacteriology (2)	296	History of Chemistry (1)	424
History (3)	37	History (3)	37
Physical Education (1)	500	English (2)	136
		Physical Education (1)	500

Figures in parentheses indicate number of credit hours a week.

THE COURSE IN CHEMICAL ENGINEERING

The requirements for admission to the Course in Chemical Engineering are given on page 18.

This course of study is designed to prepare the student for the profession of Chemical Engineer in the construction, control and management of manufacturing establishments which utilize principles of chemistry and its allied arts. Aside from the primary requirement of chemistry, the modern development of the chemical engineer enforces a thorough knowledge of physics and mathematics, together with sound understanding of such necessary fundamentals in mechanical and electrical engineering as will make him a discriminating research and operating engineer. Chemistry, physics, mathematics, as self-contained sciences or in their application to engineering, are carried throughout every year of the course.

Elementary Chemistry is begun with the Freshman year, in lectures with demonstrations, text-books and recitations. It is supplemented by experiments in the laboratory on the part of the student, acquainting him with first-hand experience of the facts of chemistry, and leading to the development of manipulative skill in experimentation, exhaustive observation and clear thinking. An alternate course, less elementary in both class-room and laboratory, is given to entering students who have had a considerable training in elementary chemistry. Entrance to this alternate course is gained by submitting proper credentials and passing a short examination held on the first Saturday after the opening of the University, as described on page 26.

After this preliminary view of the elements of chemistry, there is developed that deeper insight into the changes of matter which is the particular province of general chemistry. In Chemical Philosophy of the Sophomore year particular attention is paid to the theories and modern concepts of chemistry, including solution, equilibrium and energy relations of molecules and of atoms, radio-activity, etc.,—a kind of junior physical-chemistry of the greatest, everyday importance in chemical engineering. This study is continued in the second term as Advanced Chemistry, covering a moderately advanced study of chemical substances, their preparation and properties, together with elementary consideration of phase rule and of such general applications as the

relations underlying desirable properties in alloys, in iron and steel, etc.

Organic Chemistry is taught during the entire Junior year by means of lectures, recitations and laboratory work. The aim of the course is to familiarize the student with the simpler compounds of carbon, and later so to amplify the instruction that he shall become versed in the usefulness of this branch of chemistry in science, in the chemistry of animal and plant life, and in the manufacture of such chemical products as dyes, drugs and medicines, oils, fats, waxes, and many others.

Introduction to the chemical analysis of substances is begun through Qualitative Analysis in the second term of the Freshman year. This is a laboratory course, proceeding from the recognition of individual substances to the analysis of more complex solutions and solids. Lectures and recitations to elucidate the facts and fascinating theories underlying analytical chemistry accompany the laboratory work. The simpler mathematical relations of chemical processes are reviewed under Stoichiometry and are illustrated through many problems solved by the student. Quantitative Chemical Analysis by gravimetric, volumetric and electrolytic methods follows through the Sophomore year and the first term of the Junior year, and takes up the analysis of ores, fuels, metallurgical products, commercial chemicals and by-products. Frequent class-room conferences accompany the laboratory work and elucidate the calculations involved and the scientific foundations of quantitative analysis. The analysis of industrial organic substances and of food-stuffs, drinking and boiler waters is placed in the final term of the Senior year, when the student has a better foundation in increasing experience and a broader outlook toward the important significance of Industrial Chemistry. At this stage, too, is placed the sampling and analysis of illuminating and heating gas, flue gases and other special gases.

Fire-assaying of ores and of gold and silver bullion is taught in the summer term after the Sophomore year when continuous attention throughout the day can be given to muffles and furnaces. The practice in Assaying is accompanied by extensive consideration of the calculations and theories involved in the production of mixtures favorable for the work in hand. A course in Industrial Mineralogy, intended primarily for students in Chemical Engineering, is a part of this summer work,

and leads to familiarity with about seventy-five minerals of commercial importance. These minerals are studied in their crystalline forms, also in the forms in which they often present themselves for final utilization by the chemical engineer.

The laboratory methods of Physical Chemistry and the systematic, deeper study of generalizations of chemistry learned in the Sophomore year are reserved for the Senior year under Physical Chemistry. Interrelations of the fundamentals of matter and energy are developed under such cognate headings as two-phase and multiphase systems, thermodynamics, gas reactions, mass action, electrochemistry, colloid chemistry, etc. Attention is given to the usefulness of Physical Chemistry in the solution of manufacturing problems in Chemical Engineering.

Intensive instruction in the application of factory methods in Chemical Engineering is likewise placed in the Senior year and is grouped under Industrial Chemical Laboratory and Industrial Chemistry. The processes reviewed are varied; such as transportation of gases, liquids and solids; grinding; pulverizing; mechanical, hydraulic and pneumatic separation; evaporation; distillation; filter pressing; centrifuging; autoclaving. Characteristics and adaptability of engineering materials used in apparatus and machines receive full discussion. Selected industries are investigated and explained. Familiarity with manufacture in its scientific and economic aspects is promoted in the special laboratory fitted with industrial apparatus, the student finally submitting full working specifications for a plant designed for the preparation of some industrial product, together with estimates of cost of raw materials and cost of conversion into finished product. Lehigh University is fortunately situated in a district abounding in business enterprises which involve chemical engineering and visits are made to these plants and to factories in the nearby cities of Philadelphia and New York.

In Research Chemical Laboratory of the last term in the Senior year every student is required to solve a novel problem having a scientific basis and is expected to demonstrate some ability as an independent research worker. A short course in History of Chemistry, with individual reading of significant records, coordinates the past progress of the science and leads to a nobler pride and an enhanced initiative in the profession which the graduate enters.

Metallurgy and the subjects related thereto are taken in the Department of Metallurgy. Likewise, the necessary mechanical

engineering, so important to the chemical engineer, is given by the Department devoted to that instruction in the University. Mechanical drawing and the laying out of machine elements in the Sophomore year is followed in the Senior year by the calculations for, and design of some such pieces of machinery as jaw crushers and stirrer autoclaves. In the interim Mechanical Engineering is developed in Steam and Gas Engines of the Sophomore year, in the Engineering Laboratory of the Junior and Senior years and in the Engineering Laboratory of the summer term following the Junior year. A first acquaintance with Constructive Elements of Machinery and of Electrical Apparatus is acquired in the summer term following the Freshman year. An elementary course in the Mechanics of Materials accompanies the instruction of the first term of the Sophomore year. Many of the problems and innovations of Chemical Engineering demand a more intimate knowledge of the principles and practice of Electrical Engineering than is given in the general course in Physics; this is provided for in the Junior year under Advanced Electricity and Magnetism of the Department of Physics, and under Dynamos and Motors and Alternating Currents, with their laboratory adjuncts, of the Department of Electrical Engineering. A comprehension of the scope and general methods of Geology and Bacteriology is attained in short courses in these subjects. Bacteriology is a lecture and laboratory course, and a working knowledge of bacteriological methods as applied to water and some industrial products is achieved.

Facility of expression in his native language is an essential aid to the thought-processes and forcefulness of a chemical engineer. In addition to the usual courses in English of the beginning years, a course in English is provided for the Senior year, by which time, it is hoped, the student will have a mature appreciation of values. The study of German, a necessary tool in current chemistry, is carried by all students in the Freshman year, and provision is made for needful knowledge of French. Students who present German or Spanish for entrance will take French in the Senior year, and those who present French for entrance will take additional German in the Senior year.

An approach to the affairs of men and the problems of business and civilization is carried in some period of all four years, and is under the direction of the Head of the Course in Business Administration. The full course of lectures in Economics as

given in the University is placed in the Junior year. Related required summer reading is specified as summer work, and examination in this requirement will be held on the first Saturday following the opening of the first term. Summer reading will comprise such matter as origins of industry and their relation to science, industrial management, business law and custom and contracts.

A scientific society is attached to the Department, with a membership of teachers and students, for the presentation of original papers, discussion of current journals, and the entertainment of speakers of note in the profession of chemical engineering.

The degree granted on completion of the course is Chemical Engineer (Ch.E.).

THE COURSE IN CHEMICAL ENGINEERING

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
Advanced Algebra (3)	143	Plane Analytic Geom. (3)	145
Elementary Chemistry (2)	390	Chemistry (1)	394
Chemistry Lab. (2)	391	Qualitative Analysis (3)	395
Elementary Mechanics (3)	320	Qual. Anal. Conf. (1)	396
Dr. & El. Mach. Des. (3)	200	Stoichiometry (1)	397
German (3)	90 or 94	Elem. Mech & Heat (3)	321
English (3)	120, 121	Phys. Measurements (1)	322
Gymnasium (1)	500	Elem. Mech. Materials (1)	169
		German (3)	71 or 95
		English (3)	122, 125
		Gymnasium (1)	500

SUMMER TERM: Con. Elements of Mach. and of Elec. Apparatus, 201, 350, or industrial work. Summer Reading in Economics.

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
Differential Calculus (4)	146	Solid Analytic Geom. & Integral Calculus (4)	147
Chemical Philosophy (3)	398	Advanced Chemistry (3)	399
Quantitative Analysis (3)	400	Quantitative Analysis (4)	404
Quant. Anal. Conf. (1)	402	Quant. Anal. Conf. (2)	405
Elec. & Magnetism (3)	323	Light & Sound (3)	325
Mech. & Heat Lab. (1)	324	Light, Elec. & Mag. Lab. (1)	326
Machine Design (3)	202	Steam & Gas Engines (4)	204
English (2)	123	Physical Education (1)	500
Physical Education (1)	500		

SUMMER TERM: Assaying, 413, and Industrial Mineralogy, 414. Summer Reading in Economics.

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Quantitative Analysis (2)	406	Organic Chemistry (4)	410
Quant. Anal. Conf. (2)	407	Organic Chem. Lab. (4)	411
Organic Chemistry (3)	408	General Metallurgy (2)	245
Organic Chem. Lab. (2)	409	Metallurgy of Iron (2)	246
Advanced Elec. & Mag. (2)	328	Met. Problems (1)	247
Dynamos & Motors (2)	354	Alternating Currents (2)	375
Dynamo Lab. (1)	355	Electrical Lab. (1)	330
Engineering Lab. (2)	209	General Geology (2)	268
Economics (3)	16	Economics (3)	17
Physical Education (1)	500	Physical Education (1)	500

SUMMER TERM: Engineering Laboratory, 212. Summer Reading in Economics.

SENIOR YEAR

FIRST TERM		SECOND TERM	
Physical Chemistry (3)	419	Physical Chemistry (2)	421
Physical Chem. Lab. (1)	420	Physical Chem. Lab. (1)	422
Industrial Chem. Lab. (3)	412	Industrial Chemistry (3)	415
Non-ferrous Met. (4)	251	Research Chem. Lab. (2)	423
Met. Problems (1)	252	Industrial Analysis (3)	416
Engineering Lab. (1)	216	Industrial Anal. Conf. (1)	417
Bacteriology (2)	296	Sanitary Chem. Lab. (2)	418
Electrochemistry (1)	253	Electrometallurgy (1)	254
Electrochemical Lab. (1)	255	History of Chemistry (1)	424
Machine Design (2)	208	French (3)	73
Physical Education (1)	500	or German (3)	93
		English (2)	136
		Physical Education (1)	500

Figures in parentheses indicate number of credit hours a week.

THE COURSE IN SHIP CONSTRUCTION AND MARINE TRANSPORTATION

The requirements for admission to the Course in Ship Construction and Marine Transportation are given on page 18.

This course is a combination of engineering and economics preceded by the usual fundamental subjects common to engineering courses, namely: mathematics, chemistry, modern languages and physics. The purposes of the course are: first, to train men in the design and construction of ships; and second, having knowledge of ships, to prepare them to enter the field of ocean transportation and foreign commerce. Combining as it does engineering training with studies in business administration, such a broad course has very great advantages; the combination gives an excellent preparation for men desiring to engage in international trade.

The first and second years are devoted largely to mathematics, physics, modern languages, chemistry and mechanical drawing, all of which afford necessary preparation for the technical work in later years. Students continue in the Freshman year the modern foreign language accepted for entrance. In the Sophomore year they may elect French, Spanish or German. The second year, although devoted largely to the study of science, contains some work in engineering. The subjects of Ship Drawing in the first term and Graphic Statics in the second term of the Sophomore year are not only of direct practical value to the student who desires to enter a shipyard but also of general enginering interest.

The course in Construction, taken throughout the Freshman year, is designed to give the student a general view of engineering. Among the principal topics discussed by lectures and recitations are the history of architecture and engineering, masonry construction, streets and highways, the history of bridges, the materials of construction, foundations of bridges and buildings and the historical development of steel ships.

Surveying is given during four weeks of the summer term immediately following the close of the Freshman year, with emphasis upon the construction and use of instruments.

An important feature of this course in Ship Construction and Marine Transportation is the large amount of time devoted to the study of economics and allied subjects. To arouse the student's interest in and to fit him for the study of Marine Transportation and Foreign Commerce in the Senior year his work in Economics and Accounting is begun in the Sophomore year, followed in the

Junior year by Business Law and Finance. These subjects, followed in the Senior year by Foreign Commerce, Industrial Management, Foreign Exchange, Marine Insurance, and Contracts and Specifications, afford preparation for engaging in international trade. Moreover, this very considerable amount of time devoted to Economics affords good preparation for administrative positions in shipyards or similar industrial works.

The Junior year is devoted largely to such fundamental engineering studies as Strength of Materials, Hydraulics and Metallurgy, and to important subjects in electrical and mechanical engineering.

The work of the Senior year may be classified under the three divisions of Naval Architecture, Marine Engineering and Foreign Commerce. Naval Architecture includes studies in the design and construction of wooden, steel and concrete ships and is especially concerned with the study of hulls. Instruction in Marine Engineering is treated under the head of Heat Engines, Machine Design, Marine Engines and Marine Steam Turbines.

To give men taking this course a direct contact with the construction of ships and ship machinery an attempt is made to place them in shipyards during at least a portion of their summer vacations following the Sophomore and Junior years, one summer being devoted to the construction of hulls and the other to machine shop work.

Graduates in this course receive the degree of Naval Engineer (N.E.).

THE COURSE IN SHIP CONSTRUCTION AND MARINE TRANSPORTATION

FRESHMAN YEAR

FIRST TERM		SECOND TERM	
Advanced Algebra (3)	143	Plane Analytic Geom. (3)	145
Elementary Chemistry (2)	390	Spherical Trig. (1)	142
Chemistry Lab. (2)	391	Qualitative Analysis (3)	395
Elementary Mechanics (3)	320	Stoichiometry (1)	397
French (3)	74	Elem. Mech. & Heat (3)	321
or Spanish (3)	112	Phys. Measurements (1)	322
or German (3)	94	French (3)	74
Engineering Drawing (3)	160	or Spanish (3)	112
Construction (2)	162	or German (3)	95
Gymnasium (1)	500	Engineering Drawing (2)	161
		Construction (2)	163
		Gymnasium (1)	500

SUMMER TERM: Land and Topographic Surveying, 164.

SOPHOMORE YEAR

FIRST TERM		SECOND TERM	
Differential Calculus (4)	146	Solid Analytic Geom. &	
Elec. & Magnetism (3)	323	Integral Calculus (4)	147
Mech. & Heat Lab. (1)	324	Light & Sound (3)	325
English (3)	123, 125	Light, Elec. & Mag. Lab. (1)	326
French (3)	70 or 75	English (3)	124
or Spanish (3)	111 or 114	French (3)	71 or 75
or German (3)	90 or 98	or Spanisn (3)	111 or 114
Economics (2)	16	or German (3)	91 or 99
Ship Drawing (3)	450	Accounting (2)	26
Physical Education (1)	500	Astronomy (2)	150
		Graphic Statics (2)	166
		Physical Education (1)	500

SUMMER TERM: Work in Shipyard on Hull Construction.

JUNIOR YEAR

FIRST TERM		SECOND TERM	
Strength of Materials (4)	167	Hydraulics (3)	171
Strength of Mat. Lab. (1)	168	Hydraulic Lab. (1)	172
Metallurgy (3)	248-250	European History (3)	40
Dynamos & Motors (2)	354	Alternating Currents (2)	375
Dynamo Lab. (1)	355	Dynamo Lab. (1)	356
Heat Engines (3)	205	Marine Engines (3)	225
Business Law (2)	20	Steam Engin. Lab. (1)	217
Machine Design (2)	208	Finance (2)	18
Physical Education (1)	500	Machine Design (3)	202
		Physical Education (1)	500

SUMMER TERM: Work in Shipyard in Machine Shops.

SENIOR YEAR

FIRST TERM		SECOND TERM	
Naval Architecture (3)	451	Naval Architecture (4)	454
Ship Design (3)	452	Ship Design (3)	455
Marine Steam Tur-		Reinforced Concrete (4)	183
bines (3)	226	Contracts & Specif. (2)	184
Steam Engin. Lab. (1)	226	Foreign Exchange (2)	38
Struc. Steel Design (4)	453	Marine Insurance (2)	39
Foreign Commerce (3)	37	Shipyard Plants (2)	456
Industrial Management (2)	33	Physical Education (1)	500
Physical Education (1)	500		

Figures in parentheses indicate number of credit hours a week.

LIST OF STUDIES

Following is a complete list of studies offered by the University in its various courses. The number of exercises a week in each subject is indicated by the figures in parentheses. Two hours of drawing, three of work in the laboratory or three of practice in the field are regarded as equivalent to a recitation or lecture of one hour's duration.

UNDERGRADUATE COURSES

PHILOSOPHY, PSYCHOLOGY AND EDUCATION

PROFESSOR HUGHES, ASSISTANT PROFESSOR DROWN

Psychology

1. General Psychology. A text in applied psychology is first studied, with a view to introducing the student to the purpose and methods of modern psychology. Many class experiments are performed. Subsequently the principles of psychology are surveyed in some detail, and their importance illustrated in respect to many social, industrial, medical and educational problems. Hollingworth, McDougall, Thorndike, and periodicals. First and second terms (3).

2. General Psychology. A course similar to that outlined under 1. First and second terms (2).

3. Mental Hygiene. An introduction to the study of exceptional mental conditions. First term (2).

4. Social Psychology. The relation to essential human needs of the several forms of culture,—sport, art, the moral and religious consciousness, the spirit of science. Their origin and development. Second term (2).

5. Economic Psychology. A critical study of some of the popular literature in this field. Hollingworth's *Applied Psychology*. A course especially intended for students in engineering. First and second terms (1).

6. Experimental Psychology. A course for Seniors who wish to follow up some line of investigation touched on in the Junior year. First and second terms (1).

Philosophy.

7. History of Philosophy. An introduction to the philosophical method of dealing with the essential problems of an epoch. Rogers' *Student's History.* First term (2).

8. History of Philosophy, continued. The philosophical enterprises of recent years. Perry's *The Present Conflict of Ideals.* Second term (2).

9. Scientific Method. The history of science, with some analysis of the methods introduced at different stages and in the several fields of science. Practice in presenting and dissecting arguments. Second term (3).

Education

10. History of Education. Especial emphasis is placed upon Greek education and upon the roots of our present educational system and methods. Graves. First term (3).

11. Secondary Education. The curriculum and methods of the modern high school. Colvin's *An Introduction to High School Teaching,* followed by readings in the current literature of educational science and practice. Recitations, observations and reports. First and second terms (3).

12. Special Method. The work of the Senior year is given to preparation for the type of position which the student hopes to fill. It includes a study of recent discussions and educational experiments. Observation of high school classes, with practice teaching, is required. The following professors have arranged to give courses in special method in the studies named: French, Professor Fox; German, Professor Palmer; Latin, Professor Blake; Science, Professor MacNutt. First and second terms (3).

13. Science and Scientists. A survey of the development of scientific method, with a study of the lives of certain scientists. The relation of science to invention. First term (1).

ECONOMICS AND PUBLIC LAW

PROFESSOR STEWART, ASSISTANT PROFESSOR BOWEN

16. Economics. A study of the elementary principles of political economy. Lectures and required reading in selected works. First term (3), (2) or (1).

17. Economics. Practical economic problems; taxation, transportation, finance, labor, trusts and monopolies. Second term (3), (2) or (1).

18. Economics. Finance. Discussion of public expenditures; their nature, their relation to the industrial, political, and social conditions; their relation to the functions of government; also discussion of financial organization and administration. First term (3), or second term (2).

19. Economics. Finance. Discussion of public revenues; of revenue derived from the public domain and public industries; the apportionment, classification, and administration of taxes; the nature and employment of public credit; the origin and growth of public debts. Second term (3).

20. Economics. Elements of Business Law. The principles of contract; formation of contracts; operation and discharge of contracts; sales of goods; insurance contracts; negotiable instruments. First term (2) or (1).

21. Economics. Elements of Business Law. Principal and agent; master and servant; business associations; partnerships and corporations. Second term (2) or (1).

22. Constitutional Law. The constitutional framework and the practical operation of the Federal and State governments. The relation of government to the business and social interests of the people. Interpretation of the Constitution by the various departments of the government. Comparison of American and European practice. First and second terms (3).

23. International Law. The development of international law; its origin and history; economic and political changes determining the development of international relations; the Jus Gentium of the Roman Law and the "Natural Law" jurists. Law of Peace and War: general principles governing the normal relations of states and their relations in time of war. The Law of Neutrality, with special reference to the contributions of the United States; problems associated with blockade, contraband of war, unneutral service. First and second terms (3).

24. American Foreign Relations. Studies in the diplomatic relations of the United States with the main countries of Europe, with the Near East and the Far East. First term (3).

25. United States and Latin America. Problems arising out of the relations of South American states to one another and to

the United States. Origin, development and application of the Monroe Doctrine. Second term (3).

26. Principles of Accounting. Sole proprietorship, partnership, single entry, profit and loss in single entry, profit and loss in double entry, trial balance, balance sheet, statement of profit and loss, use of columnar books, and controlling accounts with subordinate ledgers. First term (3), or second term (2).

27. Principles of Accounting. Corporation accounting, special books required in corporation accounting, legal requirements, opening corporate books and special entries, method of handling stock, adjustment entries, profits, dividends, closing of books, balance sheet, statement of profit and loss. Second term (3).

29. Economic Geography of North and South America. Physical features, climate, and resources of the Western Hemisphere. Their influence upon the economic, political, and social institutions. Particular attention is given to the present and prospective commercial relations of the United States with Mexico, Central and South America. First and second terms (3).

30. Economic Geography of the Eastern Hemisphere. Physical features, climate, and resources of the Eastern Hemisphere. Their influence upon the economic, political, and social institutions. Emphasis is put upon the study of Great Britain, Germany, Russia, China, Japan, India, and the Philippine Islands. The present and prospective commercial relations of these countries with the United States. First and second terms (3).

31. Railroad Administration. This course considers from the administrative viewpoint railways as factors in the social and industrial development of the United States. It treats of the historical and the geographical conditions of railroad location. The organization of railroads, considering charters and franchises, capital stock, directors and stockholders. The financial and legal aspects of these organizations, and their relation to the public through commissions. First and second terms (3).

32. Labor Legislation. Labor problems confronting the employer and the more successful methods of meeting them and avoiding legal disputes. The legal status of unions and strikes. Protection of the employer's interests. Employer's Liability and Workmen's Compensation Acts. First and second terms (2).

33. Industrial Management. Practical problems confronting the industrial manager. Factors determining the location of industry. Nature of plant structure and arrangement of process. Methods of wage payment. The human element in industry. First and second terms (2).

34. Investments. A comparative study of investment values (including bonds, stocks, notes, and mortgages) and the conditions affecting the investment market; with the emphasis on the securities of corporations as investments. First and second terms (3).

35. Statistics. Statistical method and applied statistics. Practice is given in the handling and especially in the interpretation of statistics. As much research as possible is carried on. First and second terms (3).

36. Banking and Currency. A study of the banking system of the United States, comparing it with those of the important European states, together with a study of the currency and currency problems of this country. Special emphasis is laid upon the Federal Reserve Act, foreign exchange, and factors affecting the money market. First and second terms (3).

37. Foreign Commerce. This course includes a statistical study of the history of the foreign commerce of the United States and of that part of the municipal and international law that bears upon our present commerce. The technique and practical problems of the exporting and importing business are studied throughout the course. First term (3).

38. Foreign Exchange. A study of the theory of foreign exchange and of the instruments and documents used in practice. Second term (2).

39. Marine Insurance. A study of the theory of insurance in general and of its statistical and mathematical basis is followed by a study of the application of these principles to marine risks. Second term (2).

HISTORY

PROFESSOR STEWART

40. History of Europe in the Nineteenth Century. The narrative history of the period will be followed, with special emphasis on such topics as the political and economic reconstruction of Europe after the Napoleonic Wars, the revolutionary movements of 1848, the rise of Socialism, the unification of Italy and of Germany, the agrarian problem in Russia and the Balkan problem. First and second terms (3).

41. The Political and Constitutional History of the U. S. Prior to 1860. The era of constitution making, state and federal. Rise and growth of party government. The development of nationality and democracy. Political and constitutional questions arising in connection with internal improvements, the tariff, the bank and slavery. First and second terms (3).

42. Political and Constitutional History of the U. S. since 1860. A continuation of the preceding course. Given alternating with course 41. First and second terms (3).

43. Industrial History. Special attention is directed to the evolution of modern industrial conditions as found in the growth of the economic powers of Great Britain, Germany and the United States. First and second terms (2).

LANGUAGES

LATIN

PROFESSOR BLAKE

45. Livy. Selections from the books covering the war with Hannibal. Particular attention to forms and the usages of normal syntax. Latin prose compositions using Arnold's *Latin Prose*. Written translations from Latin into English. History of the struggle between Rome and Carthage. Freshman, first term, elective (3).

46. Horace. *Odes* and *Epodes.* Insistence upon tasteful translation. Constant practice in metrical reading. Memorizing of some of the odes of Horace. Latin prose composition, continued. Freshman, second term, elective (3).

47. Ancient and Mediaeval Literature and History. The course aims to impart a knowledge of ancient and mediaeval

civilization and literature by means of required readings in available English translations of writings of the times, as well as by means of text-books dealing with the course of events. Freshman, first and second terms (3).

Courses 45 and 46 are required of Freshmen in the B.A. course who enter with four units in Latin; others in that course take 47, except that those who present three units in Latin for entrance may, upon the approval of the Professor of Latin, continue Latin instead.

48. PLINY. Selected letters. Tacitus. *Agricola* and *Germania*. Consideration of social and legal usages suggested by Pliny. Some study of Roman provincial administration. Sophomore, first term, elective (3).

49. PLAUTUS AND TERENCE. Careful study of a play of each, with rapid reading of as much more as the time permits. Study of dramatic verse-structure and practice in metrical reading. History of the drama at Rome. Sophomore, second term, elective (3).

50. TACITUS. Selections from the *Histories* or *Annals*. Some consideration of Tacitus as an historian and a literary artist. Sight-reading from Suetonius. Junior or Senior, first term elective (3).

51. JUVENAL. Selected *Satires*. Selections from Martial. Satire and epigram in Roman literature. Study of social conditions under the empire as evidenced by the writings of the younger Pliny, Tacitus, Suetonius, Juvenal, and Martial. Writing of brief dissertations on assigned topics. Junior or Senior, second term, elective (3).

52. ROMAN LAW. An elementary course. Selections from the Institutes of Justinian, or Gaius, are read and commented on. Brief survey of Roman constitutional history and the development and content of the body of Roman Law, in connection with Morey's *Outlines of Roman Law*. Junior or Senior, first term, elective (3).

53. LUCRETIUS. Careful study of one book entire of *De Rerum Natura*, with reading of selections from the other books. Consideration of textual questions. Discussion of ancient materialistic theories. Some review of Roman philosophy and ethics. Junior or Senior, elective, second term (3).

54. Courses for prospective teachers of Latin in secondary schools. Largely a review of secondary school Latin, the members

of the class conducting the class in turn under the oversight of the Professor of Latin to the end that they may enter upon the teaching of Latin in preparatory or high school with freshened knowledge of the subject, and not without some experience in presenting it. Junior year, first term (2), second term (2). This course will ordinarily be taken in connection with EDUCATION, which see.

GREEK

PROFESSOR GOODWIN

55. LYSIAS, Selected *Orations;* or XENOPHON, *Memorabilia.* Review of the Grammar. Attic prose syntax is carefully studied, and special attention given to the formation of correct methods of study and translation, to grammatical analysis, and the reading aloud of Greek. Available time is employed in sight-reading. HERODOTUS. One book (begun). One hour a week for the greater part of the term is devoted to Prose Composition and a variety of practical exercises. First term (3).

56. HERODOTUS (continued). Study of the forms and syntax of the Ionic dialect. PLATO. *Euthyphro* and *Apology*, or other shorter dialogues. Introduction to Greek Philosophy. Grammar and Composition as in the first term. Second term (3).

57. THUCYDIDES. One or more books. Practical exercises, including composition, are given usually once in two weeks. First term (3).

58. TRAGEDY. EURIPIDES. *Medea*, *Bacchae*, or another play. SOPHOCLES. *Oedipus Tyrannus*, *Antigone*, or another. Literary study of the drama. Poetical language, style, and conception. Metrical reading. Composition from time to time. Second term (3).

59. DRAMATIC POETRY (continued). AESCHYLUS. *Agamemnon*, or *Prometheus Bound*. ARISTOPHANES. *Clouds*, *Frogs*, or *Birds*. ARISTOTLE. Chapters from the *Poetics*. Aristophanes as humorist and as moralist, with consideration of the tendencies which he satirized. Metres. Elementary text-criticism. First term (3).

60. GREEK ORATORY. Jebb's *Selections from the Attic Orators*. DEMOSTHENES. Selected orations. The reading is rapid, and the student is supposed to have reasonable facility in understanding the Greek directly without rendering into English. Attention is directed largely to those points which illustrate the development of Greek prose style. Second term (3).

61. HOMER. Considerable portions of the *Iliad* or *Odyssey* are rapidly read. Homeric language, syntax, and metre are reviewed, with some reference to the needs of intending teachers, but chiefly as a foundation for the study outlined in course 62. First term (3).

62. LYRIC POETRY. Fragments of the Elegiac, Iambic, and Melic Poets. Selections from PINDAR, or THEOCRITUS. Study of the development of poetry in Greece. Second term (3).

63. HELLENISTIC GREEK. *New Testament.* Selections from LUCIAN. To be substituted on occasion for 62. Second term (3).

Courses 59 and 61, 60 and 62 are given in alternate years, and are open to both Juniors and Seniors.

Candidates for honors in Greek will be assigned special readings on request.

64. ELEMENTARY GREEK. This course is offered in alternate years to Freshmen or Sophomores who have entered without Greek, but desire to take up the study in college. They perform in two years approximately the amount of work required for admission from those who present Greek, and are prepared to proceed in the third year with Course 55. The introductory book and a portion of the *Anabasis* are studied in the first two terms. Omitted in 1918-1919; will be offered for 1919-1920. First and second terms (3).

65. ELEMENTARY GREEK, second year. *Anabasis* continued; *Iliad;* Grammar and simple Composition. Omitted in the years in which the preceding course is given. First and second terms (3).

FRENCH

PROFESSOR FOX, ASSISTANT PROFESSOR TOOHY

70. ELEMENTARY FRENCH. Elementary French Grammar. Easy French texts. First term (3).

71. ELEMENTARY FRENCH, continued. Grammar and Composition. Dictation. Reading of short stories by various authors. Second term (3).

72. ELEMENTARY FRENCH. Sophomore elective for students of the B.A. course who wish three years of French. First and second terms (3).

73. FRENCH. Continuation of course 70. Scientific French. Second term (3).

74. FRENCH. Thorough review of the Grammar. Composition based on work in the Grammar. Modern French Prose. Dictation. First and second terms (3).

75. FRENCH. Continuation of course 74. Composition. Modern French Prose and Poetry. First and second terms (3).

76. FRENCH. History and Geography of France and her colonies. Commercial correspondence. Composition. First term (3).

77. FRENCH. Texts and methods. First or second term, or both (1), or (2).

78. FRENCH. Rapid reading of French Prose. First and second terms (2).

79. FRENCH. Composition course. First and second terms (2).

80. FRENCH. Rapid Reading. Sight translation. Dictation. Oral drill in the use of a practical vocabulary. First term (3).

81. FRENCH. Continuation of course 80. Second term (3).

82. FRENCH PROSE AND POETRY. Balzac, Flaubert, Maupassant, Daudet, Zola. First term (3).

83. FRENCH PROSE AND POETRY. Continuation of course 82. Molière, Corneille, Racine. Society in the seventeenth century. Second term (3).

84. FRENCH. French literature in the seventeenth century. First term (3).

85. FRENCH. French literature in the eighteenth century. Second term (3).

86. FRENCH. French literature in the sixteenth century and earlier. First and second terms (3).

87. FRENCH. General review of French Literature. Reading, lectures and explanation of texts. First and second terms (3).

88. MODERN FRENCH NOVELISTS. Bourget, Barres, France, Loti, Bazin. Collateral reading and lectures. First and second terms (3).

89. FRENCH. French literature in the nineteenth century. First and second terms (3).

GERMAN

PROFESSOR PALMER,
ASSISTANT PROFESSOR MORE, ASSISTANT PROFESSOR HILDRETH,
MR. ROEST

90. ELEMENTARY GERMAN. German Grammar and Composition. Easy German texts. First term (3).

91. Elementary German, continued. Composition based on work in the Grammar. Dictation. Reading of short stories by various modern authors. Second term (3).

92. Elementary German. A condensed course for Chemical Engineers who have entered without German. Grammar. Readings in the German of Chemistry. First and second terms (3).

93. Advanced Scientific German. Rapid reading of scientific texts. For Seniors in the Department of Chemical Engineering who offered French for entrance. Prerequisite course 92 or equivalent. Second term (3).

94. German. Thorough review of German Grammar. Prose composition. Modern German Prose. First term (3).

95. German. Continuation of course 94. Advanced composition. Scientific German. Second term (3).

96. German. German Prose and Poetry. Heine, Keller, C. F. Meyer, Freytag, Storm, Heyse. Composition. First term (3).

97. German. Continuation of course 96. Second term (3).

98. German. Lessing, Schiller or Goethe. Study of selected works. First term (3).

99. German. Goethe's *Faust*. Study of Part I. Lectures on the origin and development of the Faust story. Second term (3).

100. German. Nineteenth Century German Drama. Lectures, reading, reports on assigned work. First and second terms (3).

101. German. Goethe's Dramas: *Goetz, Egmont, Iphigenie, Tasso, Faust*, Part II. First and second terms (3).

102. German. The German Short Story, its origin and development. Rapid reading of illustrative stories, with particular attention to Gottfried Keller, Theodor Storm, C. F. Meyer, and Paul Heyse. Lectures and reports. First and second terms (3).

SPANISH

PROFESSOR FOX, ASSISTANT PROFESSOR TOOHY

110. Spanish. Spanish Grammar. Reading of easy modern texts. First and second terms (2).

Course 110 is open to Juniors and Seniors. The number of students accepted is limited as the sections are necessarily small.

111. Spanish. Grammar, reading and composition. First and second terms (3).

Course 111 is open to all students of the University.

112. SPANISH. Preparation required: 111 or equivalent. Reading and discussion in Spanish of texts dealing with the history of Latin American Countries. Prose Composition. First and second terms (3).

113. (Alternate.) Spanish novels and plays. Short outline of Spanish literature. This is a second year course, intended more especially for students in the B.A. course and may be substituted by them for course 112, dealing with Latin America. First and second terms (3).

114. SPANISH. Reading and discussion in Spanish of texts dealing with the commercial and industrial relations of Latin America. Spanish commercial correspondence. First and second terms (3).

PORTUGUESE

PROFESSOR FOX

115. PORTUGUESE. Grammar and composition. Rapid reading of modern literature, with particular reference to the history, social and economic conditions of Brazil and Portugal. First and second terms (3).

ITALIAN

PROFESSOR FOX

116. ITALIAN. Grammar and composition. Rapid reading of easy modern prose. First and second terms (3).

117. ITALIAN. Dante's *Inferno*. Interpretation, lectures and outside reading. First and second terms (3).

ENGLISH

PROFESSOR THAYER,

ASSISTANT PROFESSORS LUCH, MESCHTER AND WALTERS

120. RHETORIC. A composition course based on Genung's *Working Principles of Rhetoric* and other books, involving recitations and weekly themes on assigned subjects. First term (2).

121. AMERICAN LITERATURE. Lectures on the basis of Cairns' *History of American Literature* and other text-books, as assigned. The examination is based upon the text book and the student's notes. First term (1).

122. HISTORY OF THE ENGLISH LANGUAGE. Lectures and classroom work, with the use of Emerson's *Brief History of the English Language* as a text-book, supplemented by Lounsbury's and Champneys'. Second term (2).

123. English Literature. An outline course developed by lectures and recitations, with parallel readings assigned annually. Text-book: Pancoast's *English Literature* with a standard book of selections from English Literature. First term (2).

124. Literary Criticism. The subject varies annually between topics taken from Elizabethan Literature, lyric or dramatic, and from XIXth Century Literature, earlier or later period. Second term (2).

125. Oratory. A formal course based upon Foster's *Argumentation*, with recitations and writings of briefs, the composition and delivery of orations, and speeches on topics of current interest. First and second terms (1).

126. Anglo-Saxon. Sweet's *Anglo-Saxon Primer and Reader*, with lectures on early English Literature, and readings from Brooke and Earle. First term (3).

127. Journalism. A course of practical exercises in writing on scientific subjects and in the principles of journalism. Text-books: Bleyer's *Newspaper Writing and Editing* and Earle's *Technical Writing*. First term (3), repeated in second term (3).

128. English Philology. The principles of the Philology of the English language as developed in the works of Earle, Trench, Morris and Skeat. By a process of elimination the elements derived from Romance and other sources are excluded, and the residuum examined, in vocabulary and grammar, as a Teutonic language; with special reference to the intensive development of the tongue before the Age of Chaucer. Preparation required: 126. Second term (3).

129. XIX Century Literature; later period 1830-1892. A special study of Tennyson, Arnold and Browning and the Pre-Raphaelites. First term (1).

130. Middle English. A critical study of the English of Chaucer, Langland, Wiclif, and Gower; followed by the literary study of selected specimens of their works. As text-books, *The Student's Chaucer*, Skeat's edition of *The Vision of Piers, the Plowman*, Wiclif's translation of the *New Testament*, revised by Purvey, and Gower's *Confessio Amantis* are assigned. First term (3).

131. Poetics. A course based on Gummere's *Handbook of Poetics*, Alden's *English Verse*, Saintsbury's *Loci Critici*, and the use of Palgrave's *Golden Treasury*, and *The Oxford Book of*

English Verse, with practical exercises in verse-composition. Second term (3).

132. Drama of the Past. Based on Brander Matthews' *Chief European Dramatists;* with lectures, interpretations and a close study of plots and sources. First term (3).

133. Contemporary Drama. Lectures, criticisms and reading of typical plays. Second term (1).

134. The Danish Element in English. A philological study based on Sweet's *Icelandic Primer*, Groth's *Danish Grammar* (pp. 1-29, 67-143) and the works of Jespersen and other philologists. Alternative with 130. Preparation required: 126, 128. Second term (3).

135. Optional courses on the Rise and Development of the English Novel and on the Arthurian Cycle are offered in alternate years. These are both lecture courses, with private reading assigned; and, if supplemented by a rigid examination, will be taken as equivalent to one term's work in any class above the grade of Freshman.

136. English Conferences. Second term (2).

MATHEMATICS AND ASTRONOMY

PROFESSOR THORNBURG, PROFESSOR LAMBERT, PROFESSOR OGBURN, ASSISTANT PROFESSOR STOCKER, ASSISTANT PROFESSOR REYNOLDS, MR. KNEBELMAN, DR. LEYZERAH

140. Solid Geometry, beginning with Book VI and completing the subject. Second term (3).

141. Trigonometry. Plane Trigonometry, including the theory and use of logarithms. First term (3).

142. Trigonometry. Spherical Trigonometry, including the use of logarithmic tables. Preparation required: 140, 141, Second term (1).

143. Advanced Algebra, beginning with the Theory of Quadratic Equations. First term (3).

144. Higher Algebra. Theory of Equations and other topics. First term (1).

145. Plane Analytic Geometry. Graphic representation of loci on cross-section paper, plane analytic geometry. Preparation required: 140, 141. Second term (3).

146. Differential Calculus. Embracing applications to analytic geometry and practical problems. Preparation required: 145. First term (4).

147. Solid Analytic Geometry and Integral Calculus. General integration methods with applications to theory of center of gravity, moment of inertia, together with a short chapter on elementary ordinary differential equations. Preparation required: 146. Second term (4).

148. Differential Equations. Preparation required: 147. First term (1).

149. Analytic Mechanics. Differential equations of motion, treatment of forces in space, free and constrained motion of a particle and of masses, with applications to practical problems. Preparation required: 147. First term (2).

150. Descriptive Astronomy. A study of the fundamental facts and principles of the subject with solution of problems; observatory visits. Preparation required: 147. Second term (2) or (3).

151. Practical Astronomy. Study of instruments used, methods of taking and reducing observations to determine time, latitude, longitude, and azimuth; observatory work in which each student makes his own observations and computations in illustration of the problems studied. As this study is primarily for civil engineers, the sextant and engineer's transit are the chief instruments employed in the observational work. Preparation required: 147, 150. First term (3).

152. Analytic Mechanics. Preparation required: 147, 148, 149. Second term (3).

CIVIL ENGINEERING

PROFESSOR MC KIBBEN, PROFESSOR WILSON,
ASSOCIATE PROFESSOR FOGG, ASSISTANT PROFESSOR BECKER,
ASSISTANT PROFESSOR FULLER, MR. PAYROW, MR. BERRY

160. Engineering Drawing. The use of drawing instruments. Lettering and tracing. Mechanical drawing from objects. Simple projections. Isometric drawing. First term (3).

161. Engineering Drawing. The descriptive geometry of projections, intersections, and developments. Plans, elevations and sections of simple structural details. Preparation required: 160. Second term (2).

162. Construction. Lectures planned to give the student a general view of various branches of engineering. The principal topics discussed are: history of engineering, including the lives of some noted engineers and scientists; history and types of architecture; modern building construction, including steel frames and fire-proofing; masonry; types of retaining walls and dams; materials of construction; water supply and sewage disposal; development and transmission of water power; history of bridges. First term (2).

163. Construction. Lectures and recitations on foundations, especially of bridges and buildings; street and highway construction. Computations for foundations of simple structures. Second term (2).

164. Land and Topographic Surveying. The theory and practice of land surveying, including computation of areas, dividing land, determining heights and distances. Map drawing and topographic signs. Field work with level and transit. Map drawing from students' field notes. Theory and use of stadia. Detailed field work in rough country; pen topography and contour maps. Illustrations with and problems in the sand box. Preparation required: plane trigonometry and mechanical drawing. Summer term; a recitation and seven hours of field work or drawing each week day for four weeks beginning June 30, 1919.

165. Stereotomy. Problems in stone cutting, including plans for piers, culverts, and arches. Isometric drawings and linear perspective. Preparation required: 160, 161. First term (3).

166. Graphic Statics. Analysis of the stresses in roof trusses by the force polygon. Applications of the equilibrium polygon to the discussion of beams and girders. First or second term (2).

167. Strength of Materials. The elasticity and strength of timber, brick, stone, and metals. Theory of beams, columns, and shafts, with the solution of many practical problems. Preparation required: 320, 321, 323, 147. First term (4).

168. Strength of Materials Laboratory. Each student makes fourteen experiments on wood, iron and steel to determine the action of materials under stress and to study the physical properties of materials of construction. The Fritz Engineering Laboratory, wherein this work is done, is equipped with 20,000, 50,000, 100,000, 300,000, and 800,000-pound machines for tension, compression, and flexure, a 50,000-inch-pound machine for torsion and

other apparatus for special work. Preparation required: 167. First term (1).

169. Elementary Mechanics of Materials. Brief introduction to elements of strength of beams, columns and shafts, especially as applied to elementary machine design. First term (1), or second term (1).

170. Engineering Problems. Applications of mathematics, mechanics, heat, electricity, light, sound, and strength of materials to practical engineering problems. Preparation required: 167. First term (2).

171. Hydraulics. Hydrostatics and theoretical hydraulics. The flow of water through orifices, weirs, tubes, pipes, and channels. Naval hydromechanics. Hydraulic motors. The solution of many practical problems. Preparation required: 320, 321, 323, 147. Second term (3).

172. Hydraulic Laboratory. Each student makes fourteen experiments in the hydraulic section of the Fritz Engineering Laboratory, which is equipped with pumps, weirs, turbines, waterwheels, meters and other apparatus for special work. Preparation required: 171. Second term (1).

173. Roofs and Bridges. The theory and computation of stress in roof and bridge trusses under dead, live and wind loads. Locomotive wheel loads on plate girders and bridge trusses. Preparation required: 167. Second term (3).

174. Railroad Surveying. Reconnaissance, preliminary and location methods, with the theory of curves and turnouts. Location of a line, with the preparation of profiles and maps. The computation of earthwork and estimates of cost. Preparation required: 164. Second term (4).

175. Bridge Design. Lectures and recitations. Discussion of the theory of structural steel design and complete calculations for a through plate girder railroad bridge and for a highway truss bridge, both of which are designed and drawn in course 176. Preparation required: 173. First term (2).

176. Bridge Design Drawing. Complete shop drawing for a single track through railroad bridge and a design drawing of a highway truss bridge for which calculations are made in course 175. Preparation required: 173. First term (4).

177. Hydraulic Engineering and Design. Three recitations and one drawing room exercise per week are devoted to systems of

water supply, including purification systems, reservoirs, pipe lines, pumping plants. The design of a water supply distribution system. The measurement of flow in open channels by means of tubes and meters. Water power. Irrigation. Preparation required: 171. First term (4).

178. Railroads. The construction of the roadbed; including ballast, crossties, rails, switches, culverts, and other details. Maintenance of way, and the elements of railroad operation. Visits of inspection, with written reports. Lectures on the economics of railroad location; the arrangement of yards, stations and terminals, train resistance, the application of electricity to the operation of railroads. Preparation required: 174. First term (2).

179. Geodetic Surveying. Recitations, calculations, field work. Precise leveling. Adjustment of instruments with investigation of their systematic errors. Elements of least squares and the application to the adjustment of triangulations. Field work in triangulation, in determination of azimuth, and with the plane table. Preparation required: 174. First term (3).

180. Mill Buildings. Design of roof trusses and three-hinged arches. Mill building construction. Preparation required: 173. First term (2).

181. Bridges and Dams. Higher structures, including continuous, draw, cantilever, and suspension bridges, also metallic arches. The theory and design of masonry walls, dams, and arches. Theory of deflections and applications to statically indeterminate structures. Preparation required: 175. Second term (4).

182. Sanitary Engineering. Systems of sewerage and methods of sewage treatment and disposal. The design of a sewerage system. House drainage. Preparation required: 177. Second term (3).

183. Reinforced Concrete. The manufacture, properties, and testing of hydraulic cement, mortar, and concrete. Each student makes all the standard tests on cement and on reinforced concrete beams and columns in the Fritz Engineering Laboratory. Reinforced concrete buildings, arches, and other structures; theory of reinforced concrete. Preparation required: 175. Second term (4).

184. Contracts and Specifications. Lectures on the essentials of contracts and specifications for engineering structures. Second term (2).

185. Ship Construction and Ocean Transportation. Design and construction of steel merchant ships. Hull construction. Terminal facilities, including steamship piers, railroad connections, dry docks. Ocean trade routes and ship canals. Ocean freight rates and terminal charges. Second term (2).

SUMMER SCHOOL IN CIVIL ENGINEERING

164. Land and Topographic Surveying. Exercises in Land Surveying and Topographic Surveying, designed primarily for students of the University, but open to all persons prepared to take them, are given in the summer vacation. In 1919, this work begins at 8 a.m., on June 30, and ends on July 29. Students in Civil Engineering, Mining Engineering and in Ship Construction and Marine Transportation are required to take this work at the end of their Freshman Year. The fee for other persons is $20.00.

MECHANICAL ENGINEERING

PROFESSOR DE SCHWEINITZ, PROFESSOR KLEIN,
ASSOCIATE PROFESSOR BUTTERFIELD, ASSISTANT PROFESSOR SPENCER,
MR. BEAMENSDERFER, MR. QUAST

200. Drawing and Elements of Machine Design. Orthographic, isometric and oblique projections, intersections and developments. Sketches and working drawings of machine pieces, tracings, details of screw-fastenings, keys and other fastenings. Students taking this course are required to take Course 169, Elementary Mechanics of Materials. Text-book: *Engineering Drawing* by T. E. French. First term (3).

201. Constructive Elements of Machinery. Visits of inspection. Examination and sketching of machine parts and machinery. A classified and numbered list of some three hundred and sixty items is given to each student, who makes a written report on them with freehand sketches containing the leading dimensions. The class is divided into sections, which are separately taken into shops by the instructor, who then indicates the pieces that are to be examined and gives all necessary explanations. In addition a score of machines of all sorts are taken apart and again put to-

gether by this class. This work is accompanied by Constructive Elements of Electrical Apparatus, No. 350. Summer term 4 weeks, beginning June 30, 1919.

202. Elements of Machine Design. Calculation of the dimensions of elementary machine parts such as spur-, bevel- and worm-gears, pulleys, shafting, couplings, bearings, connecting rods, etc., from the forces acting upon or transmitted by such machine parts. Working drawings of these pieces. Text-book: Leutwiler's *Elements of Machine Design.* Preparation required: 169 and 200. Second term (3).

203. Boilers. Description of various types, and details of construction, staying, setting, etc.; strength of the structure; accessories; fuels and furnaces; operation; wear and tear; visits of inspection to a boiler shop and to a boiler plant. Text-book: Parson's *Steam Boilers.* First term (1).

204. Steam Engines. Elementary Thermodynamics, theory of the ideal heat engine, properties of steam and efficiency of the steam engine. Mechanics of the engine, steam pressures, inertia resistances, turning force diagrams, etc. Valve gears, valve diagrams applied to slide valves, shaft governors, and link motion. The steam engine indicator and study of diagrams. Outline of the study of economy, compounding, etc. The descriptive work is supplemented by shop visits. The solution of many graphical and numerical problems is required. Text-book: Heck's *Steam Engine.* Second term (4).

205. Heat Engines. Short course for students in courses other than Mechanical Engineering, covers Steam Engines, Steam Turbines, Internal Combustion Engines and Boiler Plants. Text-books: Hirshfeld and Ulbricht's *Steam-Power and Gas-Power.* First term (3).

206. Heat Engines. Work of 205 completed. Second term (3).

207. Mechanical Technology. Each student is required to give a full written description of the various processes, operations, and tools involved in the production of each one of a series of properly graded examples of patterns, castings, forgings and finished pieces, which are under construction in the shops at the time. The student's work is personally directed by an instructor, who accompanies him in each shop, giving necessary explanations, and tests the extent and accuracy of his knowledge. Four teachers are

engaged in this work, one for each shop and section. Summer term, four weeks, beginning June 30, 1919.

208. Graphic Statics of Mechanisms. Graphical determination of the forces acting on all the various pieces constituting a machine, covering a great variety of machines. Drawings of these machines on which the graphical solutions are to be worked out are given to the students. Frictional and inertia resistances are considered and the efficiencies of mechanisms are determined. First or second term (2).

209. Engineering Laboratory. Use and calibration of apparatus for measuring weight, volume, pressure, temperature, speed, etc., for engineering purposes. First term (2).

210. Engineering Laboratory. Work of 209 continued. Indicator practice on engines in the laboratory and in factories and power plants in the neighborhood; complete working up of indicator diagrams from simple and compound engines, air compressors, etc. Second term (1).

211. Machinery of Transmission. *Machinery of Transmission*, Weisbach-Herrmann series: Vol. III, Part I, Section 1. This treats of the Mechanics of Machine Parts and determines their dimensions from considerations of strength and durability. The Introduction is also studied for its analytical presentation of the subject of acceleration. First term (3).

212. Summer School in Engineering Laboratory. Simple tests with steam; steam calorimeters, injectors, flow of steam, performance of steam-traps, etc.; tests of small steam pumps, of a steam turbine, of engine performance; of hot-air and gas engines, and of an air compressor. Boiler management and testing. Dynamometer work, belt testing, friction and lubrication. Summer term, four weeks, beginning June 30, 1919.

213. Thermodynamics. Proof of the fundamental laws; equations of condition for air and superheated steam; the relations between pressure, volume, temperature, work and heat for special changes of state. Establishment of the fundamental equations of thermodynamics and their adaptation to gases and technical problems. Text-book: Zeuner's *Technical Thermodynamics*. First term (5).

214. Kinematics of Machinery. This treats of the constrained motion peculiar to machinery and of the nature and equivalence of mechanisms. As here pursued it consists of a few lectures ac-

companied by a large amount of work in the drafting room. The work is expended on the construction of centrodes, in inversions and skeletons of mechanisms and also on the preparation of displacement, velocity and acceleration diagrams for a great variety of machines. This is followed by much practice in mass and force reductions, the latter including all forms of inertia resistance and external forces. Text-book: A. W. Klein's *Kinematics of Machinery*. Second term (4).

215. Advanced Machine Design. This covers the design of machines in general; especial attention is given to the calculation and designing of the various parts for strength, stiffness and other requirements. The problems cover such machines as cranes, hoists, pumps, machine tools, hydraulic machinery, etc. First term (4).

216. Engineering Laboratory. Work of 212 and 214 continued. Tests of boilers, of power plants and of pumping stations in the neighborhood. Advanced work along the lines of 213. First term (1).

217. Engineering Laboratory. A shorter course, selected and condensed from 209 to 221, especially in steam engineering, for students in Metallurgical and Mining and Electrical Engineering. First or second term (1).

218. Engineering Laboratory. Work of 217 completed, along same lines. Second term (1).

219. Advanced Machine Design. This is a continuation of course 215, being more specialized. Second term (4).

220. Mechanics of Machinery. This covers the principles involved in the design and construction of machinery such as hoisting-, pumping- and air-machinery, locomotives, etc. Second term (3).

221. Engineering Laboratory. Work of 216 carried forward, along same lines. Analysis of flue gases; complete tests of the power plants of the vicinity. Second term (1).

222. Gas Engines. The Mechanics, Thermodynamics, Thermo-Chemistry, Construction, and Tests of the Gas Engine. Text-book and reference book: Streeter's *Internal Combustion Engines*. First term (3).

223. Steam Turbines. The Mechanics, Thermodynamics, Construction and Experimental Results of Stationary and Marine Steam Turbines. Text-book: Stodola's *Steam Turbines*. Second term (5).

224. Mechanical Engineering. Under this general head one or two of the following courses will be given, viz., plant engineering, refrigeration, aeronautics, marine engines, etc. Second term (3).

225. Marine Engines. Course for students taking the course in Ship Construction and Marine Transportation. Text-book: E. M. Bragg's *Design of Marine Engines and Auxiliaries.* Second term (3).

226. Marine Steam Turbines. Course for students in Ship Construction and Marine Transportation. First term (3).

METALLURGY

PROFESSOR RICHARDS,
ASSISTANT PROFESSOR ROUSH, MR. BUTTS

244. Introductory Metallurgy. A course of lectures on the history of the metals, details of the distribution of their ores and the geographical distribution and conditions of their production; their present economic and mechanical importance; a general study of their chemical and physical properties, touching particularly on their thermophysical and thermochemical relations. When possible to arrange, visits will be made to metallurgical plants, to acquaint the student with the general features of metallurgical apparatus, their appearances and their working. First term (2).

245. General Metallurgy. Metallurgical processes. Principles of combustion. Principles of thermo-chemistry. Measurements of high temperatures. Fuels, natural and artificial, solid and gaseous. Fluxing. Refractory materials. Classification of furnaces. Artificial draft and blast. Electric furnaces. Reference books: Hofman's *General Metallurgy*, Second Edition; Fulton's *Principles of Metallurgy.* Second term (2).

246. Metallurgy of Iron. Chemical and physical properties of iron. Iron ores. Preparation of ores. The blast furnace. The mixer. Remelting. Refining. Puddling. The Bessemer process. The open hearth process. Duplex processes. Cementation. Manufacture of crucible steel. Electric steel. Direct processes. Casting, forging and heat treatment. Reference books: Ledebur's *Eisenhüttenkunde*, Stoughton's *Metallurgy of Iron and Steel.* Second term (2).

247. METALLURGICAL PROBLEMS. A course of problems embodying the use of the physical, chemical and mechanical principles at the basis of practical metallurgy. The data are taken from actual practice, and the results have an important bearing on the understanding of metallurgical processes. Reference: Richards' *Metallurgical Calculations*, Parts I and II. Second term (1).

248. GENERAL METALLURGY. Shorter course. Reference books: Fulton's *Principles of Metallurgy*, Hofman's *General Metallurgy*. First term (1) or second term (1).

249. METALLURGY OF IRON, STEEL AND OTHER METALS. A shorter course. Reference books: Stoughton's *Metallurgy of Iron and Steel*. Gowland's *Metallurgy of Non-Ferrous Metals*. First term (1) or second term (1).

250. METALLURGICAL PROBLEMS. A course of problems embodying the use of physical, chemical and mechanical principles utilized in practical metallurgy, particular attention being paid to the needs of the Civil, Mechanical and Electrical Engineer. Richards' *Metallurgical Calculations*, Vols. I and II. As above, First term (1) or second term (1).

Courses 248, 249 and 250 are an abridgment of Courses 245, 246, 247 and 251, for Students of Civil, Mechanical and Electrical Engineering, Ship Construction and Marine Transportation.

251. METALLURGY OF COPPER, LEAD, SILVER, GOLD, ZINC, TIN, MERCURY, NICKEL, ALUMINIUM, ETC. Copper: Chemical and physical properties. Ores. Smelting sulphide ores. The Bessemer process. Treatment of oxide ores. Wet processes. Electrolytic processes. LEAD: Chemical and physical properties. Ores. Smelting processes. Condensation of lead fume. Refining and desilverization of base bullion. SILVER: Chemical and physical properties. Ores. Smelting with lead. Amalgamation. Leaching processes. GOLD: Chemical and physical properties. Ores. Gold washing. Gold milling. Chlorination. The cyanide process. Parting gold and silver. ZINC: Chemical and physical properties. Ores. Belgian and Silesian processes for the manufacture of spelter. Manufacture of zinc oxide. Electrolytic processes. MERCURY: Chemical and physical properties. Ores. Processes of extraction. ALUMINIUM: Chemical and physical properties. Ores. Extraction by electrolysis. TIN, NICKEL, PLATINUM, ANTIMONY, etc.: Chemical and physical properties; Ores; Alloys; Processes of Extraction.

Reference books: Schnabel's *Handbook of Metallurgy*, Gowland's *Metallurgy of the Non-Ferrous Metals*, Hofman's *Metallurgy of Copper*, Hofman's *Lead*, Collins' *Silver*, Rose's *Gold*, Ingall's *Zinc*, Richards' *Aluminium*, Louis' *Metallurgy of Tin*, Wang's *Antimony*. First term (4); for E.M. students (2).

252. Metallurgical Problems. A course of problems concerned with the principles utilized in the metallurgy of the non-ferrous metals. Reference: Richards' *Metallurgical Calculations*, Part III. First term (1).

253. Electrochemistry. Lectures discussing the phenomena of electrolysis and the various theories proposed to account for them. Special consideration of secondary reactions, and also of the quantitative relations between electrical and chemical energy, and their mutual convertibility. Reference books: Le Blanc's *Textbook of Electrochemistry*. Allmand's *Applied Electrochemistry*. First term (1).

254. Electrometallurgy. Lectures discussing the practical application of electricity to metallurgical processes. Electrolytic and electric furnace plants and practice. Reference books: Borcher's *Electric Smelting and Refining*. Neuberger's *Handbuch der Praktischen Elektrometallurgie*. Second term (1).

255. Electrochemical Laboratory. Quantitative separations and depositions of metals by electrolysis. Experimental determination of the conditions controlling the nature of electrolytic deposits. Electrolysis of salts. Cathodic Reduction. Fee, $5; deposit, $5. First term (1).

256. Metallurgical Laboratory. Calibration and use of instruments employed in metallurgical investigations, pyrometers, calorimeters, etc. Determination of specific heats, latent heats of fusion and vaporization, vapor tensions, heats of combustion, heats of chemical combination and reaction. Heat conduction and radiation. Determination of efficiencies of furnaces. Experiments with electrochemical processes, electric furnaces, etc. Fee, $10; deposit, $10. Second term (2).

257. Metallography. The study of Metals and Alloys: their physical, chemical and microscopic properties together with deductions drawn therefrom. The influence of thermal and mechanical treatment on physical properties and structure. Lectures and laboratory work. Fee, $10; deposit, $10. Reference books: Gulliver's *Metallic Alloys*, Sauveur's *Metallography and Heat Treatment of Iron and Steel*. First term (2).

258. Metallurgical Design. Execution of designs accompanied by working drawings and estimates of material and cost for the erection of metallurgical and electrometallurgical plants under given conditions. Second term (2).

259. Metallurgical French or German. Reading of technical journals or books with the Head of the Department. First term (1).

260. Seminary. A conference hour of the Head of the Department with his students, to discuss current metallurgical processes and problems, and thesis work, involving some reading of current literature and other preparation on the part of the students. First term (1). Second term (1).

261. Thesis for Degree. Every student in Metallurgy is required to present a thesis on some topic which will require original literary and other work, such as observations, calculations, or experimental tests when practicable.

For summer schools, see courses 350 and 413, also statement on page 127.

GEOLOGY

PROFESSOR MILLER, ASSISTANT PROFESSOR TURNER, MR. FRETZ

266. Mineralogy. The principles of crystallography with practice in the determination of forms on models and crystals. The physical properties, origin, occurrence, association, and alteration of minerals. Methods of study and classification. A study of about one hundred and fifty of the common mineral species and varieties, particularly the rock-forming minerals, with practice in identification based on association and physical properties. First term (4).

(A deposit of $5 is required from each student taking course 266, to cover damage to collections and instruments and the value of supplies furnished him. In case the damage consists only of ordinary wear and tear the amount retained to cover it is about $3 for each student.)

267. Blowpipe Analysis. A course in qualitative blowpipe analysis and special chemical tests in which the chemical and physical behavior of all of the common chemical elements and their compounds under various conditions is noted. The object of the course is to acquaint the student with methods of rapid

qualitative testing as a means of identifying minerals and chemical compounds with the aid of the blowpipe. Fee, $4. First term (2).

268. General Geology. A course in dynamic, structural, and historical geology. The text-book is supplemented by illustrated lectures in which the relation of geology to engineering problems is discussed. The different geologic periods and their characteristic types of life are studied. The principles of organic evolution as shown in the development of new forms in the successive periods are treated; also a brief review of the geology of the North American continent and the physical changes which it has undergone during its development. Second term (2).

269. Petrology, Geological Laboratory, and Field Trips. This course is designed primarily to enable students to determine and to classify the various types of rocks without the use of the microscope. The principles of rock classification are discussed in a series of lectures which are supplemented by laboratory practice with a petrologic collection comprising rocks gathered from all parts of the world. Attention is also given to the examination of the varieties of rocks used for constructional purposes with discussions of the factors which render them desirable. In addition, a series of lectures is given on primary and secondary rock structures, supplemented by laboratory work on the interpretation and construction of topographic and geologic maps and sections. During the spring months, field trips are taken weekly to nearby localities to study rock structures and deposits of economic importance. The region furnishes excellent examples of varied structures and contains numerous quarries where slate, cement rock, limestone, sandstone, gneiss, and serpentine are obtained, all of which are visited by the classes. On such field trips, special attention is given to the methods of geologic mapping. Second term (3), (2) or (1).

(A fee of $1 is required of each student taking course 269 to cover damage to collections and the value of supplies furnished.)

270. Economic Geology. The non-metallic minerals and substances; their origin, modes of occurrence, properties, sources, production and uses are studied. Comprehensive reports on various products comprise a portion of the work. Preparation required: 266, 268 and 269. First term (2).

271. Economic Geology. Metallic Minerals. Causes of the formation of cavities in rocks, their relation to metalliferous de-

posits; discussion of the theories of ore-deposition; the structure, geological horizon, and geographic distribution of the principal metallic economic deposits of the United States. Recitations, illustrated lectures, field trips, and laboratory work. For the purpose of studying ore occurrence, visits are made to the zinc mines of Franklin Furnace and Friedensville, the magnetite mines of Dover, New Jersey, and Cornwall, Pennsylvania, the limonite mines of Ironton, and the anthracite coal mines. Each student is required to prepare a series of maps illustrating the location, production, chemistry, and geology of the economic products of the United States. Preparation required: 268 and 269. Second term (4).

272. Paleontology. An elementary course in paleontology in which the animal life of the past is considered both from the biological and geological viewpoints. Theories of origin and evolution of life are outlined, and principles of stratigraphy and paleontology are discussed. Index fossils of the successive geologic periods are studied in the laboratory and practice in the identification of fossils is afforded. Preparation required: 268 and 269. Second term (3).

273. Geology of North America. The geological age and geographical distribution of the rocks of which North America is composed; the structure and history of its mountain ranges; the history of its geological development and origin; reviews of the great surveys that have been made. Lectures and laboratory work. Preparation required: 268 and 269. Second term (3).

274. Physiography. The cosmic relations of the earth; the classification of land forms; the study of their origin, growth, and decay and the factors governing their development; their geographical distribution. Topographic maps; the relation of topography to geologic structure. The response of man and other organic life to an inorganic environment with special reference to the influence of physiography upon the economic development of countries. Second term (3) or (2).

275. Field Geology. Geological maps—their use and the methods by which they are constructed. Practice in the actual working out of surface geology. Problems in plotting geology on topographic maps; each student will be assigned a definite area and will be required to make a geological map of it with structure sections. He will also collect a full set of specimens to illustrate

the geology. The first part of the course will be devoted exclusively to field work and the notes then taken will be worked up in the laboratory when the weather prevents further out-door work. A fee of $1 is charged to students taking this course. Preparation required: 268 and 269. First term (3).

276. Petrography. The optical properties of minerals and their study with the petrographic microscope. Petrography of the more important igneous rocks. Lectures, recitations, and laboratory work. A laboratory fee of $3 is charged all students taking this course. Preparation required: 266 and 325. First term (2).

277. Physiography. A study of topographic forms and the processes that have produced them; the weather and climate; and the influence of physical conditions upon the development of countries. Salisbury's *Physiography* is used as a text-book. First term (3).

278. Physiography. A continuation of Course 277. Recitations, lectures, laboratory work, and field trips. In this work a study is made of the physiographic regions of North America and Europe. The student becomes familiar with topographic maps and the preparation of weather and climate charts. Emphasis is placed on the effect that physiographic conditions have in determining the commercial and industrial importance of nations. Second term (2).

279. Mining and Geologic Law. A study of the legal matters that confront a mining geologist. The law in regard to underground waters and mineral products is studied and abstracts of important cases, accompanied by drawings showing the geologic conditions upon which the decisions were made, are prepared. First term (1).

280. Structural Geology. The study of special features of structural geology in the field and laboratory. First term (1).

281. Geologic Methods. The study of methods employed by the geologist in the various lines of geologic investigation. In this study the student is made familiar with the methods employed by the United States Geological Survey and by the mining companies that employ geologists. Special attention is given to the problems that confront an economic geologist in the investigation of coal lands, oil properties, metal mines, etc. Second term (3).

BIOLOGY

PROFESSOR HALL, MR. REX

290. Botany. An elementary course treating of the structure and classification of plants. Lectures, laboratory work, and reference to text-books. Preparation advantageous: 292. Second term (2).

291. Forestry. Lectures, recitations and laboratory work. The lectures cover a brief introduction to botany. This is followed by lectures on dendrology and text-book work on Forestry. The laboratory work is devoted mainly to dendrology and the characteristics of the wood of important timber species. Field trips during the autumn enable the student to become familiar with the trees of the region. First term (3).

Careful consideration has been given by friends of the University and by the Board of Trustees to the matter of Forestry as one of the very live issues of the day in connection with the general attention that is now being directed to the conservation of our natural resources. It does not appear to the Trustees that at the present time the call for professional foresters is such as to justify the establishment of a School for Forestry at the University, but it seems that the question is of such great and growing importance that the University should do its part toward calling the attention not only of its students but of the public in the section of country more directly reached by the influence of the University, to the growing need of a better knowledge of the principles involved. To this end, courses of lectures have been instituted to which the public has been invited and special instruction is being given in Forestry in certain of the courses.

In furtherance and support of the cause of Forestry the University has offered free tuition scholarships to graduates of the Pennsylvania State School of Forestry at Mont Alto, to pursue, as special students at this University, courses supplementary and cognate to their studies at Mont Alto.

292. Biology. Lectures, recitations, and laboratory work. The lectures discuss the following topics: (*a*) fundamental conceptions; life, protoplasm, the cell, etc.; (*b*) the structure, development, relationships, habits, and geographic distribution of animals; (*c*) the more important biological theories; variation, heredity, evolution, etc. In the laboratory, types of the various phyla are dissected and drawings made. First term (3).

293. Comparative Anatomy of Vertebrates. Lectures on the comparative anatomy of vertebrates, with a more extended discussion of biological theories. The laboratory work consists of the dissection of types of the several vertebrate classes. Preparation required: 292. Second term (3).

294. Vertebrate Embryology. Lectures, reading and laboratory work. By the study of living, preserved, and sectioned material, the successive stages of cleavage, gastrulation, and the formation of organs are demonstrated. Preparation required: 293. First term (2) or (3).

295. Sanitary Biology. Lectures, recitations, assigned reading and laboratory work. Study of bacteria; microscopical appearance, methods of staining, plate and tube culture, etc. The quantitative and qualitative bacteriological and microscopical examination of water. Second term (3).

296. Bacteriology. Recitations and laboratory work. After the general study of bacteria, special attention is paid, in this course, to those forms which are economically important, such as those of water, foods, dairy products, soils, etc. Preparation advantageous: 290 or 292. First term (2).

297. Advanced Bacteriology. Lectures and recitations on the study of disease, immunity and sanitation. Laboratory work on the determination of species, with a special study of the pathogenic bacteria. Opportunity is given for the independent study of special problems in practical hygiene. Preparation required: 295 or 296. Second term (2). (Not offered in 1919-20.)

298. Physiology. A course in normal physiology, hygiene and sanitation. Its object is to give that knowledge of the body and its functions which all should have. A text book is chosen which emphasizes the application of such knowledge to personal hygiene and public sanitation. While some previous training in biology is of great value, it is not an absolute necessity. Second term (2).

(A fee of $3 is required in courses 292, 295, 296, and 297, to cover cost of material and breakage.)

DR. ESTES

299. Hygiene. Lectures intended to teach the students some idea of the importance and the methods of personal hygiene and sanitary laws will be given during the course. It is also intended

to suggest to young men who may become engineers, miners, and explorers the importance of and how to take proper measures for the sanitary comfort and personal well-being of men who may, in after life, be under their control and leadership.

MINING ENGINEERING

PROFESSOR ECKFELDT, ASSISTANT PROFESSOR BARTLETT

300. Mechanical Drawing. The use of instruments. Lettering and tracing. Isometric drawing. Sketches and working drawings of simple machine parts. Blue printing. Descriptive Geometry. Projections, intersections, and developments of cylinders, prisms, cones, etc. Application to graphical solution of mining problems. First term (3). Second term (3).

301. Mining Engineering. Prospecting. Modes of occurrence of minerals. Uses of geology. Prospecting for placers, veins and beds. Magnetic prospecting. Drilling. Sampling. Valuation of property. Location of claims. Patenting mining ground. Boring. Uses of bore-holes. Methods; by percussion and rotation. Special methods. Shaft sinking by boring. Survey of bore-holes. Exploitation. Location of plant. Rock drilling; tools and machines. Explosives; blasting; safety regulations. Shaft and slope sinking; tunneling. Supporting excavations by timber, metal, masonry, or concrete. Systems of mining underground and at the surface. Haulage. Surface and underground methods. Motors and cars; wire rope, aerial tramways. Loading and unloading, storage of minerals. Transportation of workmen. Signaling. First term (4).

302. Ore Dressing. General principles and physical properties upon which the recovery of minerals, or metals from ores are based, followed by detailed study of machines and apparatus used in modern practice for coarse and fine crushing; classifying and preparation for concentration; various methods of concentration, including gravity and magnetic methods, oil flotation, etc.

Application of above methods to various ores; mill schemes or flowsheets. Study of procedure followed for treatment of ores and coal in typical modern concentrating plants.

Mill location, construction, arrangement of machinery, operation, and costs. Visits to mills and anthracite breakers.

Ore Dressing Laboratory. Experimental work and tests on ores, giving practical application of principles and processes covered. A well equipped modern laboratory gives opportunity

for individual as well as class operation of the most approved machinery for the preparation of ores. Deposit, $10. First term (3).

303. Mining Engineering. Hoisting. Motors, ropes, attachments, receptacles. Safety appliances. Systems of hoisting. Drainage. Surface water; prevention of access. Mine dams. Tunnel drainage. Mechanical drainage; water hoisting; pumping. Classes of pumps. Ventilation. Atmosphere of mines. Pollution of air. Natural and mechanical methods of ventilation; systems. Types and efficiencies of ventilating machines. Instruments for testing air. Ventilation laws. Lighting. Methods employed. Safety lamps; electric lighting. Safety regulations. First Aid. Accidents; classes, causes. Means of prevention. Rescue work. Hygiene of mines; rules and laws. First Aid to injured. Railroad Construction. Earthwork, trackwork, trestles, bridges, railroad structures, water tanks, yards. Second term (4).

304. Mine Surveying. Instruments. Forms of notes. Outside work. Determination of meridian. Inside work. Connecting outside and inside work through shafts, slopes, or tunnels. Calculation of notes; mapping. Railroad Surveying: preliminary and location methods; theory of curves, turnouts, etc. Care of maps. Detection of errors. Special problems. Fee, $1. Summer term at the end of Junior year, four weeks, beginning June 30, 1919.

305. Mining Engineering. Construction Materials. The use of stone, brick, concrete, metal and wood for foundations, piling, dams, reservoirs, retaining walls, mine buildings, railroads, trestles, tipples, ore bins and docks. Mine Administration. Organization, employment of labor, management, mine accounts, principles of mining. First term (3).

306. Oil and Gas Technology. Origin and distribution of petroleum and natural gas. General survey of the geological conditions surrounding their accumulation. Oil shales. Prospecting and mapping. Location of wells. Drilling; pumping. Special methods. Storage. Pipe lines. Tank cars. Second term (2).

307. Mining Design. The design of parts of mining plant to meet given conditions, with detailed working drawings, accompanied by estimates of material and costs. Second term (3).

308. Prospecting. Surface indications of minerals, including oil, gas and water. Geological interpretation of strata and outcrops. Prospecting on surface and underground. Boring; magnetic prospecting. Mapping. Sampling and valuation of prospects. Locating and patenting claims. First term (2).

PHYSICS

PROFESSOR MAC NUTT,
ASSISTANT PROFESSOR WILY, ASSISTANT PROFESSOR CHARLES,
ASSISTANT PROFESSOR FRY, MR. MARTIN, MR. POMEROY,
MR. RAMENSTEIN, MR. ZINSZER

320. ELEMENTARY MECHANICS. Statics. Lecture demonstrations and recitations. First term (3).

321. ELEMENTARY MECHANICS. Dynamics. Heat. Lecture demonstrations and recitations. Second term (3).

322. PHYSICAL MEASUREMENTS. Laboratory and lectures. Second term (1).

323. ELEMENTARY PHYSICS. Electricity and Magnetism. Lecture demonstrations and recitations. First term (3).

324. PHYSICAL LABORATORY. Mechanics, Heat and Electricity. First term (1).

325. ELEMENTARY PHYSICS. Light and Sound. Lecture demonstrations and recitations. Second term (3).

326. PHYSICAL LABORATORY. Electricity, Magnetism, Light and Sound. Second term (1).

327. ELEMENTARY PHYSICS. A brief general course. Lecture demonstrations, recitations and laboratory. First term (3). Second term (3).

328. ADVANCED THEORY OF ELECTRICITY AND MAGNETISM. Lectures and recitations. Ferro-magnetism, electro-magnetism, Induced Electromotive Force and Inductance, Magnetic Properties of Iron, Electric Charge and the Condenser, Electric Field, Potential, Electric Oscillations and Waves, Electron Theory, Electrolysis. First term (2).

329. ELECTRICAL LABORATORY. Precise measurements. First term (1).

330. ELECTRICAL LABORATORY. Precise measurements. (Continuation of 329.) Second term (1).

331. ELECTRICAL LABORATORY. Advanced experimental studies and tests. (Continuation of 330.) First term (1).

332. THEORETICAL PHYSICS. Elective courses are offered in the Theory of Heat, in the Theory of Electricity and Magnetism, and in the Theory of Optics. Arrangements as to topic and as to time to be devoted to it are made for each group of students who elect Theoretical Physics. First or second term (3) to (5).

333. Physical Research. Special advanced students may elect to pursue experimental investigations in Physics. Arrangements as to topic and as to time to be devoted to it are made for each individual student. First or second term (2) to (4).

334. Photometry and Illumination. Lectures and recitations. Illuminant Standards, Measurements of Light and of Illumination, Laboratory Methods and Devices, Commercial Methods and Experiments, Comparison of Illuminants and Illuminating Devices, Practical Installations. First term (1).

A fee of $6 is required in connection with courses 322, 324, 326, 329, 330, 331, and 333.

ELECTRICAL ENGINEERING

PROFESSOR ESTY, ASSOCIATE PROFESSOR SEYFERT,
ASSISTANT PROFESSOR BEAVER, ASSISTANT PROFESSOR GRUBER,
MR. ESHBACH

350. Constructive Elements of Electrical Apparatus. Studies of electrical machinery and appliances with the object of familiarizing the student with principles of operation, structural details, and practical uses. The student is supplied with a complete printed outline of the work to be done containing full instructions and explanations. The work consists of three parts, as follows: (*a*) Illustrated lectures, (*b*) Inspection and sketching of electrical machines and apparatus, and (*c*) Visits of inspection to neighboring electric light and power plants. Written reports are required on each days work. Fee, $3. This work is accompanied by Constructive Elements of Machinery, No. 201. Summer term, four weeks, beginning June 30, 1919.

351. Electrical Distribution. Systems of direct current distribution; wiring formulas and applications; installation of electrical machinery and apparatus; interior wiring, overhead and underground construction; rules and regulations of the National Board of Fire Underwriters. Preparation required: 350. First term (2).

352. Dynamos and Motors. Review of principles of electricity and magnetism with special reference to their application to the dynamo. The construction, operation and control of direct current machinery; practical operation and management of dynamo machines; station equipment; cost of electrical energy; electromagnets, magnetism of iron; characteristic curves, armature windings. Illustrative problems. Preparation required: 322, 351. Second term (3).

353. Dynamo Laboratory. Introductory course supplementing the class work of 352. Experimental studies and tests of direct current generators, motors, and appliances, for characteristics, regulation, efficiency, insulation, etc. Fee, $6. Preparation required: 322, 351. Second term (1).

354. Dynamos and Motors. This is an abbreviated course adapted to those students who do not continue this subject in the following year. It treats of the principles and practice of direct current engineering, and includes: the elementary theory, construction, operation and control of direct current generators and motors, electromagnets, solenoids, automatic starters and controllers, station equipment, storage batteries. Illustrative problems. Preparation required: 323, 324. First term (2).

355. Dynamo Laboratory. Introductory course supplementing the class work of 354. Experimental studies and tests of direct current generators and motors for characteristics, regulation, efficiency, etc. Fee, $6. Preparation required: 323. First term (1).

356. Dynamo Laboratory. Continuation of 355 and supplementing the class work of 362 or 379. Advanced testing of direct current machines; practice is given in operating and testing alternating current apparatus. Fee, $6. Preparation required: 355, 354. Second term (1).

357. Theory of Alternating Currents. The elementary principles of alternating currents. Lectures, recitations and problem work. Preparation required: 352, 326. First term (3).

358. Dynamo Laboratory. Continuation of 353. Advanced testing of direct current machines. Fee, $6. Preparation required: 352, 353. First term (1).

359. Theory of Alternating Currents. Continuation of 357. Advanced theoretical studies of alternators, synchronous motors, and synchronous converters. Preparation required: 357. Second term (2).

360. Electrical Engineering. Application of physical and mathematical principles to the analysis and solution of problems relating to direct and alternating current circuits and apparatus; transient phenomena, use of complex quantities; non-harmonic periodic wave forms. Preparation required: 328, 357. Second term (2).

361. Electrical Engineering. This course is particularly adapted to students who do not further specialize along electrical lines. It includes systems of generation, transformation, distribution and transmission of electrical energy by direct and alternating currents; the application of electric motors to various industries; overhead and underground construction; estimates and costs. Preparation required: 354, 355. Second term (2).

362. Dynamo Laboratory. Continuation of 358. Advanced testing of direct current machines. Alternating current testing begun. Fee, $6. Preparation required: 357, 358. Second term (1).

363. Alternating Current Machinery. Study of the structural details, characteristics and operation of alternators, alternating current motors, rotary converters, and transformers; application of vectors. Preparation required: 329, 359, 360. First term (4).

364. Dynamo Testing. Lectures on the methods of testing electrical machinery and apparatus, including direct current generators, motors, and motor generator sets. Special methods of testing large machines; commercial tests as carried out by the large manufacturing companies. Preparation required: 328, 357, 358. Second term (1).

365. Dynamo Testing. Continuation of 364. Lectures on testing of alternating current machinery and apparatus, including generators, motors, rotary converters, transformers, induction regulators, etc. Preparation required: 359, 364. First term (1).

366. Dynamo Laboratory. Advanced experimental studies and tests of direct and alternating current generators and motors, synchronous converters, transformers, and auxiliary apparatus; measurement of power in polyphase circuits. Fee, $12. Preparation required: 359, 360, 362. First term (3).

367. Electrical Design. Application of electric, magnetic and mechanical principles to the design of electromagnetic mechanisms, direct current generators and motors; predetermination of characteristics and performance; armature windings. Lectures, recitations, problems, drafting. Preparation required: 359, 360, 362. First term (3).

368. Electric Stations. Consideration of prime movers; generating machinery, discussion of types and operation; auxiliary machinery and transformers; storage batteries and their application; switch-boards, measuring and protective devices; design and arrangement; station characteristics; sub-stations; operation

and management; visits to neighboring plants. Preparation required: 355 or 356, 360 or 361. First term (2).

369. Electrical Engineering Seminary. A weekly meeting is held in the department reading room for discussion of topics from the current journals of theoretical and applied electricity. Presentation of papers on assigned topics; new inventions and discoveries critically reviewed. Preparation required: 357, 360. First term (1).

370. Electrical Design. Continuation of 367. Application of electric, magnetic and mechanical principles to the design of alternating current machinery and apparatus; predetermination of characteristics and performance; armature windings. Lectures, recitations, problems, drafting. Preparation required: 363, 366, 367. Second term (2).

371. Electric Traction. The construction, equipment and operation of different types of electric railways. The application of electric traction under steam railroad conditions; the dynamics of electric train movements; predeterminations of speed-time curves and the power required for different types of runs. Choice of car equipment; cost of construction and of operation. Testing of railway systems. Visits of inspection to power plants are made and reports required. Preparation required: 363, 368. Second term (3).

372. Electric Power Transmission. The long distance transmission of power by electricity for use in lighting, traction, mining and manufacturing work. Comparison of electric transmission and other systems. The design, construction, maintenance and protection of lines; the effects in inductance and capacity on the operation of the power systems; the generating plant and receiving systems. Preparation required: 357 or 363, 360 or 361, 363. Second term (3).

373. Electrical Engineering Seminary. Continuation of 369. Reports on thesis work are presented and discussed. Preparation required: 369. Second term (1).

374. Dynamo Laboratory. Continuation of 368. Advanced alternating current testing. Fee, $12. Preparation required: 363, 354, 366. Second term (2).

375. Alternating Currents. This course follows Course 354 and covers the principles and practice of alternating current engineering. It includes the theory of alternating currents with ap-

plications to alternating current generators, motors, transformers and other apparatus; systems of transmission and distribution; electric lighting. Preparation required: 354. Second term (2).

376. Inspection Report. During the vacation between the Junior and Senior years each student in Electrical Engineering is required to inspect some electric railway system, lighting or power plant, or other electrical installation, and prepare a written report thereon. A descriptive outline of the installation which the student proposes to inspect must be submitted to the Professor of Electrical Engineering before July 12th, and after approval the detailed report must be handed in before September 19th. These reports should contain such calculations, photographs, drawings and plots as each individual case may require.

377. Thesis. Until this year each candidate for the degree of Electrical Engineer was required to present a thesis upon a subject chosen by the candidate during the first term of the Senior year. At present the thesis is not required, but the candidate is allowed the choice between preparing a thesis and taking Course 378 in Electrical Communication. The work upon which the thesis is based is done during the second term. It consists in part of reading from references, and in part of independent work in theory, experimental research or designing. Reports of progress in thesis work are required from time to time during the term. Second term (3).

378. Electrical Communication. A survey of the methods of electrical communication, principles of various systems of wire telegraphy, wire telephony, radio telegraphy and telephony, radio laboratory measurements, radio practice of the U. S. Signal Corps. Preparation required: 357 or 375. Second term (3).

A fee of $6 for each term-hour (period) of dynamo laboratory work taken per term is required of each student.

For Summer Schools, see Courses 201, 350, 206, and 375, also statement on page 127.

CHEMISTRY

PROFESSOR ULLMANN, ASSOCIATE PROFESSOR BABASINIAN, ASSOCIATE PROFESSOR DIEFENDERFER, ASSISTANT PROFESSOR BECK, ASSISTANT PROFESSOR CHAMBERLIN, ASSISTANT PROFESSOR LONG, ASSISTANT PROFESSOR COBB, DR. DARBY, MR. EVERHART, MR. CARTER, MR. ANDERSON, MR. FEHNEL, MR. BUCKLEY, MR. BOYD

390. Elementary Chemistry. Description of the non-metallic and metallic elements and their compounds. Lectures illustrated by experiments, diagrams, working drawings, and specimens from the museum. Note-books on the lectures required. Text-book: Kahlenberg's *Outlines of Chemistry*. First term (2).

391. Chemistry Laboratory. Experiments covering a systematic study of the chemical and physical properties of the more important elements and their compounds. Text-book: Long and Chamberlin's *Experimental General Chemistry*. First term (2).

392. Chemistry Laboratory. For B.A. students. Shorter course than course 391. First term (1).

393. Theoretical Chemistry. This course is intended for those students who have passed the examination in Elementary Chemistry held on the first Saturday of the term. Text-book: Senter's *Inorganic Chemistry*. First term (2).

394. Chemistry. Continuation of 390 and 393. Second term (1).

395. Qualitative Analysis. Practical work in the qualitative laboratory, accompanied by lectures and recitations. Text-book: Treadwell's *Analytical Chemistry*, Vol. I. Second term (3).

396. Qualitative Analysis Conference. Special consideration of science underlying Qualitative Analysis. Second term (1).

397. Stoichiometry. Chemical problems and reactions. Text-book: Long and Salisbury's *Chemical Calculations*. Second term (1).

398. Chemical Philosophy. Lecture Course, with recitations. Theories of Chemistry; physical and chemical methods of determining atomic and molecular weights, thermo-chemistry, dissociation, solutions, catalysis, electrolysis, radio-activity, non-metallic elements and their compounds. Prerequisite: courses 390 or 393, 391, 395, 397. Text-book: Mellor's *Modern Inorganic Chemistry*. First term (3).

399. Advanced Chemistry. Lecture course, with recitations. Phase rule, solid solutions, colloid chemistry, metallic elements and their compounds. Prerequisite: Course 396. Text-book: Mellor's *Modern Inorganic Chemistry*. Second term (3).

400. QUANTITATIVE ANALYSIS. Practical work in the quantitative laboratory, accompanied by lectures and recitations. Acidimetry, alkalimetry, chlorimetry, and the determination and analysis of simple chemical compounds and ores. Text-book: Treadwell's *Analytical Chemistry*, Vol. II. First term (3).

401. QUANTITATIVE ANALYSIS. Shorter course. Practical work in the quantitative laboratory. Analysis of simple chemical compounds, ores and metallurgical products. First term (3).

402. QUANTITATIVE ANALYSIS CONFERENCE. Lectures and recitations concerning the laboratory work of Courses 400 and 401. First term (1).

403. QUANTITATIVE ANALYSIS. Continuation of Course 401. Second term (3).

404. QUANTITATIVE ANALYSIS. Continuation of Course 400. Analysis of minerals, ores, slags, alloys, electrolytic analysis, etc. Text-book: Treadwell's *Analytical Chemistry*, Vol. II. Second term (4).

405. QUANTITATIVE ANALYSIS CONFERENCE. Lectures and recitations concerning laboratory work of Courses 401 and 400. Second term (2) or (1).

406. QUANTITATIVE ANALYSIS. Continuation of Course 401. Ores and alloys, complete analysis of iron and steel; also gas analysis, mineral water analysis, etc. Text-books: Treadwell's *Analytical Chemistry*, Vol. II, Lord and Demorest's *Notes on Metallurgical Analysis*, Hempel's *Gas Analysis*. First term (2).

407. QUANTITATIVE ANALYSIS CONFERENCE. Discussions concerning the laboratory work of Course 406. First term (2).

408. ORGANIC CHEMISTRY. Lectures and recitations. Typical compounds of carbon, their classification, general relations, and methods of preparation of important compounds. Text-book: Bernthsen's *Organic Chemistry*, translated by Sudborough. First term (3).

409. ORGANIC CHEMISTRY. Laboratory work. Determinations of specific gravities, melting points, boiling points, vapor densities; qualitative and quantitative determinations of carbon, hydrogen, nitrogen, and the halogens. The preparation of pure organic compounds. Text-books: Gattermann-Schober's *Practical Methods of Organic Chemistry*, Levy's *Organisch-Chemische Präparate*. First term (2).

410. Organic Chemistry. Continuation of course 408. Lectures and recitations. Second term (4).

411. Organic Chemistry. Laboratory work. Continuation of Course 409. Practical methods of saturation, nitration, reduction, diazotisation, sulphonation, etc. Preparation of pure compounds. Study of the properties of dyes and other commercial products. Text-books: Gattermann-Schober's *Practical Methods of Organic Chemistry*, Levy's *Anleitung zur Darstellung organisch-chemischer Präparate*, Cohen's *Practical Organic Chemistry*. Second term (4), (3) or (2).

412. Industrial Chemistry. Engineering fundamentals, including machinery and materials of chemical plants, transportation of gases, liquids and solids, grinding, pulverizing, screening, filtration, evaporation, distillation, etc. Laboratory work includes the application of these fundamentals, with reports on various problems of chemical engineering. First term (3).

413. Assaying. Lectures and laboratory practice in the furnace assay of the ores of lead, tin, gold, silver and of gold and silver bullion. Cyanidization. Calculations for slag and slag mixtures. Text-book: Lodge's *Notes on Assaying*. Summer term: four weeks.

414. Assaying and Industrial Mineralogy. This covers much of the ground of Course 415. In addition there is instruction and laboratory work in Industrial Mineralogy, embracing about 75 minerals and rocks. It is intended primarily for Chemical Engineers. Summer term, four weeks, beginning June 30, 1919.

415. Industrial Chemistry. Continuation of 412. Lectures, problems and inspection trips on chemical processes and industries. Second term (3).

416. Industrial Analysis. Analysis of commercial products. Laboratory work. Text-book: Allen's *Commercial Organic Chemistry*. Second term (3).

417. Industrial Analysis Conference. Lectures concerning the laboratory work of Course 413. Second term (1).

418. Sanitary Chemistry Laboratory. Qualitative and quantitative examination of drinking water and food-stuffs. Second term (2).

419. Physical Chemistry. Lectures and recitations. Text-book: Lewis' *A System of Physical Chemistry*. First term (3).

420. PHYSICAL CHEMISTRY LABORATORY. Physico-chemical measurements. Text-book: Findlay's *Practical Physical Chemistry*. First term (1).

421. PHYSICAL CHEMISTRY. Continuation of 419. Second term (2).

422. PHYSICAL CHEMISTRY LABORATORY. Continuation of 419. Second term (1).

423. RESEARCH CHEMISTRY LABORATORY. Investigation approved by the Professor of Chemistry of some novel problem, involving exhaustive laboratory and library study. Second term (2).

424. HISTORY OF CHEMISTRY. Chronological development of the science, with assigned reading. Second term (1).

Deposits to cover breakage, chemicals, etc., are required as follows: Ten dollars each in Courses 416 and 420; fifteen dollars in courses 391, 418 and 423; twenty dollars in Course 409; twenty-five dollars in Courses 395, 401, 406 and 412; thirty dollars each in Courses 400, 403, 404, 413 and 414; forty dollars in Course 411. The unused portion of the deposit is returned to the student.

SUMMER SCHOOLS. Courses in Qualitative Analysis and Stoichiometry begin July 29, 1919, and continue four weeks. The course in Quantitative Analysis begins on the same date and continues for five weeks. The required course in Assaying begins June 30 and a second course may be given later. They are open to all persons prepared to take them.

SHIP CONSTRUCTION AND MARINE TRANSPORTATION

PROFESSOR MC KIBBEN, ASSOCIATE PROFESSOR FOGG, ASSISTANT PROFESSOR BECKER

450. SHIP DRAWING. One recitation and two drawing periods a week. Types of ships. Steel ship construction, including framing, shell plating, bulkheads, tanks, machinery space, holds, shaft tunnel. Structural details. Registration societies and their requirements. General drawing of a steel merchant ship. Preparation required: 161. First term (3).

451. NAVAL ARCHITECTURE. Mechanics of naval architecture. Areas. Integrators. Displacement. Buoyancy. Stability, Gravity, Trim, Launching, Tonnage, Strength of hulls. Preparation required: 167 and 171. First term (3).

452. Ship Design. Calculations and drawings of a steel merchant ship. Lines. Weights. Longitudinal and transverse strength. Midship section. Important parts of hull. Laying off. Preparation required: 451. First term (3).

453. Structural Steel Design. Two lectures and two drawing periods a week. Discussion of principles underlying the determination of stresses in, and the design of, plate girders and steel trusses, supplemented by calculations and drawings. Preparation required: 167. First term (4).

454. Naval Architecture. Waves. Rolling. Freeboard. Resistance of ships. Propulsion by screw propellers and sails. Ventilation and draining. Preparation required: 451. Second term (4).

455. Ship Design. Continuation of 452. Design and drawing of main structural features of a steel merchant ship. Frames. Bulwarks. Shell plating. Preparation required: 453. Second term (3).

456. Shipyard Plants. Study of several existing shipyards. Essential features of shipyards, including shops, machine tools, mold loft, railroad facilities, ways, cranes, dry docks. Preparation required: 453. Second term (2).

PHYSICAL EDUCATION

PROFESSOR REITER, MR. BARTLETT

500. Gymnasium. Class exercises in the open air, consisting of setting-up work for correct carriage. Work with dumb bells, wands, and Indian clubs to stimulate circulation, respiration, muscular action and to produce co-ordination and grace. Squad work on the heavy apparatus is given to develop strength in the larger muscles; recreative work in games and competitive exercises, to develop the play and combative elements. Stress is laid upon vigorous athletic dancing. The various drills and athletic dances are accompanied by music. During the fall and winter the regular gymnasium work may be replaced by Rugby and soccer football, lacrosse, wrestling and basketball. During the spring, Varsity and Freshman baseball, tennis and lacrosse may be substituted for regular, required gymnasium work. All students who participate in an organized sport, under the oversight of the Director, are excused from the regular gymnasium work during the period of that sport. Special instruction

is given in boxing and wrestling. Stress is laid upon athletic and æsthetic dancing. In addition to the regular required gymnasium work, each student in order to receive credit must swim at least the length of the pool. During the fall and winter months opportunity to learn to swim is afforded, under a competent instructor. Classes in the modern dances are held twice a week during part of the winter. Voluntary classes in advanced apparatus work are conducted for those who are interested. Short talks are given to the Freshmen on personal hygiene and the physiology of exercise. Entering students are given a thorough physical examination, and a medical examination by the consulting physician, who is in attendance also at athletic contests. Advice is given as to postural and physical defects. Each student receives a plotted card showing his defects and his relation to the normal student. The privilege of a second physical examination is given, thus affording a comparative statement and plotting of the student's physical condition. Freshmen, Sophomores, Juniors, Seniors and graduate students are required to do two hours' gymnasium work under supervision, unless participating in an organized sport, in season. First and second terms; for Freshmen, Sophomores, Juniors, Seniors, Graduate Students, (1).

501. First Aid to the Injured. This course is designed to give the student a practical knowledge of the most efficient methods of giving first aid to the injured. A brief resumé of the important points in anatomy will be taken up, followed by consideration of shock, dislocation, fractures, rabies, hemorrhage, burns, sunstroke, frost bite, electricity and lightning stroke, poisons and their antidotes, drowning, asphyxiation, railroad and mining injuries. Students will be required to do practical work in bandaging, applying splint and tourniquets, and to become familiar with the ordinary first aid materials and methods of transporting the injured. Second term (1).

CONFERENCE DEPARTMENT

PROFESSOR LAMBERT,
PROFESSOR PALMER, PROFESSOR ULLMANN, PROFESSOR MAC NUTT

The Conference Department provides extra instruction in Mathematics, Modern Languages, Physics, and Chemistry for Freshmen and Sophomores. Provision is made for two classes of students.

Class A. Any student who wishes to clear up some difficulty in the Mathematics, Modern Languages, Physics, or Chemistry of the Freshman or Sophomore year, should consult the teachers in the Conference Department on Wednesday and Saturday afternoons.

There is no fee for Class A students.

Class B. Students who are advised by the Dean or by the Heads of Departments or by the Committee on Standing of Students to take extra instruction in the Conference Department, or students who decide to do so of their own volition, can arrange for extra instruction for any period not less than one week by consulting the Director of this Department, who will be found in his office in Packer Hall at 6:45 P.M. on Monday, Tuesday, Thursday and Friday of each week. The hours of instruction are from 7 to 8 and 8 to 9 on the evenings of these four days.

The Fee of Class B Students, $1.50 for four consecutive recitations, must be paid in advance to the Bursar.

EXTENSION COURSES

During the year 1918-19, the extension courses of the University have been of two kinds:

1. Courses not of collegiate grade given in the Lehigh Evening School, which is also the practice school of the Department of Philosophy and Education. These include courses in Mathematics, Mechanical Drawing, Blue Print Reading, Machine Design, Applied Electricity and Metallurgy.

2. Courses certified to be of collegiate grade. Below is the list of such courses offered. All courses marked "G" may be offered by graduate students toward the higher degrees; courses marked "g" may be so offered under conditions prescribed by the department offering the course, and with the express consent of the Committee on Higher Degrees. The letter "e" is used to indicate courses that are open to students not matriculated in the University.

PHILOSOPHY, PSYCHOLOGY AND EDUCATION

PROFESSOR HUGHES, ASSISTANT PROFESSOR DROWN

EDUCATION. 1e. EDUCATIONAL PSYCHOLOGY. *Psychology of the Common Branches*, Freeman; *The Educative Process*, Bagley. (2) or (3).

EDUCATION. 2eg. PSYCHOLOGICAL MEASUREMENTS AND MENTAL HYGIENE (2).

EDUCATION. 3eg. SOCIAL PSYCHOLOGY. A psychological study of sport, art, morality, and religion. (2).

EDUCATION. 4e. ELEMENTARY SCHOOL METHODS. *Teaching in the Elementary School Subjects*, Rapeer. (2)

EDUCATION. 5eg. EXPERIMENTAL EDUCATION. *Experimental Education*, Rusk. (2)

EDUCATION. 6e. EDUCATIONAL MEASUREMENTS. *Educational Measurements*, Monroe, de Voss and Kelly. (2)

EDUCATION. 7eG. EDUCATIONAL MEASUREMENTS. Investigations and Reports. (2)

EDUCATION. 8eG. SECONDARY EDUCATION. *Introduction to High School Teaching*, Colvin. (4)

EDUCATION. 9eG. SCHOOL ADMINISTRATION. *Public School Administration*, Cubberley. (4)

EDUCATION. 10eG. SEMINAR IN EDUCATION. Reports and Discussions. Saturday P.M.

EDUCATION. 11e. HISTORY OF EDUCATION. Athens, The Renaissance, Rousseau, Herbart, Schools of Today, and of Tomorrow. (3)

EDUCATION. 12e. EDUCATIONAL SOCIOLOGY. *Syllabus*, Snedden. (2) or (4)

PHILOSOPHY. 1eg. HISTORY OF PHILOSOPHY. Evenings or Saturday A.M.

PHILOSOPHY. 2e. THE RELIGION OF PHILOSOPHY. *The Republic* and the *Symposium*, Plato; The Works of William James. (2)

PHILOSOPHY. 3e. ELEMENTARY LOGIC. *Logic*, Jones. (2)

ECONOMICS, PUBLIC LAW AND HISTORY

PROFESSOR STEWART, ASSISTANT PROFESSOR BOWEN

ECONOMICS. 1e. BUSINESS LAW. Contracts, agency and labor, business associations. Lectures and discussions. (2) Evenings.

ECONOMICS. 2e. ACCOUNTANCY. Theory of debit and credit, depreciation, reserves and surplus, financial statements, corporation accounting, cost accounting. Lectures and discussions. (2) Evenings.

ECONOMICS. 3e. INVESTMENTS. The securities of corporations, bonds of governments, and municipalities; speculation; investments. Lectures and discussions. (2) Evenings.

ECONOMICS. 4e. CORPORATION FINANCE. Forms of business organization, promotion and methods of securing capital, management of capital, reorganization and bankruptcy. Lectures and discussions. (2) Evenings.

ECONOMICS. 5eg. SOCIOLOGY. Sociological and economic theory, and problems to which this theory may be applied.

ECONOMICS. 6e. BANKING. Principles of banking, and the place of the bank in the business world. Lectures and discussions. (2) Evenings.

HISTORY. 1e. INDUSTRIAL HISTORY OF THE UNITED STATES. *Economic History of the United States*, Bogart; *Outline of Industrial History*, Cressy. (2) Saturday.

HISTORY. 2e. POLITICAL AND SOCIAL HISTORY OF MODERN EUROPE. Lectures and discussions. Special reference to the causes of the World War. (2) Evenings.

LATIN

PROFESSOR BLAKE

LATIN. 1e. A course corresponding to the work of the Freshman year in college. (2), (3) or (4). Evenings or Saturday A.M.

LATIN. 2eg. An advanced course. (3) Saturday A.M.

FRENCH

PROFESSOR FOX, ASSISTANT PROFESSOR TOOHY

FRENCH. 1e. ELEMENTARY FRENCH. (3) Evenings or Saturday A.M.

FRENCH. 2e. ELEMENTARY FRENCH, continued. Course in reading and conversation. (3) Evenings or Saturday A.M.

FRENCH. 3eG. RECENT FRENCH LITERATURE. Investigation and discussion of phases of French life as exemplified in French literature. Rapid reading. (3) Tuesday, Thursday, Friday, 4:30 to 6 P.M.

SPANISH

PROFESSOR FOX, ASSISTANT PROFESSOR TOOHY

SPANISH. 1e. ELEMENTARY SPANISH. (3) Saturday A.M., or Tuesday, Thursday, Friday, 4:30 to 6 P.M.

SPANISH. 2e. ELEMENTARY SPANISH, continued. (3) Saturday A.M., or Tuesday, Thursday and Friday, 4:30 to 6 P.M.

GERMAN

PROFESSOR PALMER, ASSISTANT PROFESSOR MORE

GERMAN. 1e. ELEMENTARY GERMAN. German Grammar and Composition. Easy German Texts. (2) Saturday A.M.

GERMAN. 2e. INTERMEDIATE GERMAN. German Prose and Poetry. Heine, Keller, Meyer, Freytag, Storm, Heyse. (3) Saturday A.M.

GERMAN. 3e. Goethe's *Faust*, Part I. Lectures and Composition, or Nineteenth Century German Drama. (3) Saturday A.M

GERMAN. 4eG. Goethe's Dramas, or Schiller's Life and Works, or Middle High German. (3) or (5) Afternoons, 4 to 6.

GERMAN. 5e. Teachers' Course in methods of teaching, discussion of text-books, phonetics of German, advanced German grammar and syntax, advanced composition. (2) Saturdays or afternoons.

ENGLISH

PROFESSOR THAYER,

ASSISTANT PROFESSORS LUCH, MESCHTER AND WALTERS

ENGLISH. Summer courses only will be provided at present, to meet any specific demand, of a grade corresponding to the work of the Freshman class in college in either term; the details to be arranged between the applicant and the instructor offering each course. During the past academic year a course was given in English Composition.

METALLURGY

PROFESSOR RICHARDS, ASSISTANT PROFESSOR ROUSH, MR. BUTTS

METALLURGY. 1e. GENERAL METALLURGY. (2) Evenings.

METALLURGY. 2e. METALLURGY OF IRON AND STEEL. (2) Evenings.

GEOLOGY

PROFESSOR MILLER, ASSISTANT PROFESSOR TURNER

GEOLOGY. 1e. GENERAL GEOLOGY. Lectures, field trips and laboratory. Study of geologic processes and results. (4) Saturday P.M.

GEOLOGY. 2e. GEOLOGY OF PENNSYLVANIA. Lectures, field trips and laboratory. Geological history of the State and its bearing on economic and political development. (4) Saturday P.M.

GEOLOGY. 3e. APPLICATIONS OF GEOLOGY to the teaching of Physical Geography. Illustrated lectures; discussion of school problems. (4) Evenings.

GEOLOGY. 4eG. The graduate courses listed on page 134 may be pursued as extension courses by qualified students.

BIOLOGY

PROFESSOR HALL, MR. REX

BIOLOGY. 1eg. GENERAL COURSE. Lectures, laboratory and discussions. (2), (3), (4) Saturday P.M.

BIOLOGY. 2eg. COMPARATIVE ANATOMY. Lectures, laboratory and discussions. (2), (3), (4) Saturday P.M.

BIOLOGY. 3eg. BACTERIOLOGY AND SANITARY BIOLOGY. Lectures, laboratory and discussions. (2), (3), (4) Saturday P.M.

BIOLOGY. 4eg. EMBRYOLOGY. Lectures, laboratory and discussions. (2), (3), (4) Saturday P.M.

BIOLOGY. 5eg. The graduate course listed on page 136 may be pursued as an extension course by qualified students. Afternoons, 4 to 6, or Saturdays.

BIOLOGY. 6eg. FORESTRY. Lectures, laboratory and discussion. (3) Saturday P.M.

PHYSICS

PROFESSOR MAC NUTT, ASSISTANT PROFESSOR CHARLES, ASSISTANT PROFESSOR FRY, MR. FRAIM

PHYSICS. 1e. ELEMENTARY PHYSICS. A brief general course; lectures, demonstrations, recitations and laboratory. (4) Saturday P.M.

ELECTRICAL ENGINEERING

PROFESSOR ESTY,
ASSOCIATE PROFESSOR SEIFERT, ASSISTANT PROFESSOR BEAVER,
ASSISTANT PROFESSOR GRUBER, MR. ESHBACH

PRINCIPLES OF DIRECT CURRENT GENERATORS AND MOTORS. 1e. This course of twenty weeks is arranged for high school graduates, or for men who have had some algebra, plane geometry, mechanics, and heat. It includes the study of the principles of direct currents, Ohm's law, the magnetic circuit, line drop, generators,

motors, efficiency and losses, motor starters, automatic starters, storage batteries and direct current plant operation. Two evenings, one for class work, the other for laboratory work, are required. Laboratory fee, $5, in addition to a charge of $10 for the course. (2) Evenings.

PRINCIPLES OF ALTERNATING CURRENT MACHINERY. 2e. This course of twenty weeks is arranged as a continuation of course 1e above described. The preparation required is course 1e, or its equivalent. About eight weeks are spent in the study of alternating currents and the working of numerous numerical problems. The remaining twelve weeks are devoted to a study of the alternating current generator, synchronous motor, transformer, synchronous converter, single and polyphase induction motors, etc. Two evenings a week are required. Laboratory fee, $5, in addition to a charge of $10 for the course. (2) Evenings.

CHEMISTRY

PROFESSOR ULLMANN, ASSISTANT PROFESSOR LONG,
ASSISTANT PROFESSOR CHAMBERLIN, MR. ASHBY

CHEMISTRY. 1e. ELEMENTARY CHEMISTRY, with laboratory. (2) or (4) Laboratory fee of $10, in addition to a charge of $10 for the single and $20 for the double course. A summer course only.

SUMMER TERMS

Summer term courses are required as follows: Land and Topographic Surveying at the end of the Freshman year in the courses in Civil Engineering, Mining Engineering and Ship Construction and Marine Transportation; Constructive Elements of Machinery and of Electrical Apparatus at the end of the Freshman year in the courses in Mechanical Engineering, Metallurgy, Electrical Engineering and Chemical Engineering; Mechanical Technology at the end of the Sophomore year in the courses in Mechanical and Electrical Engineering; Assaying at the end of the Sophomore year in the courses in Metallurgy, Mining Engineering and Chemistry; Assaying and Industrial Mineralogy at the end of the Sophomore year in the course in Chemical Engineering; Engineering Laboratory at the end of the Junior year in the courses in Mechanical Engineering and Chemical Engineering; Mine and Railroad Surveying at the end of the Junior year

in the course in Mining Engineering. In certain cases students may, with the approval of the Heads of their Departments, substitute industrial work for summer courses. Students not connected with the University may be admitted to the courses in Surveying if properly qualified. For this purpose special arrangement must be made with the Professor of Civil Engineering for the courses in Land and Topographic Surveying, and with the Professor of Mining Engineering for the course in Mine and Railroad Surveying.

GRADUATE COURSES

Courses leading to the degree of Master of Arts or Master of Science may, by permission of the Faculty, be pursued by any properly qualified person who has taken the Bachelor's degree or a degree in technology at any recognized college, university or technical institution. These courses require at least one year of advanced study in residence at Lehigh University in two departments (under two professors), or at least two years of such study in non-residence. Residence is construed as continuous attendance at the University and living under its jurisdiction. Permission to enroll for study in non-residence will be granted only in exceptional cases to students who possess ample facilities for study and work and usually only to students who can report periodically in person for conferences with the professors under whom they are studying.

The course of study selected must consist of at least fifteen exercises a week. Two-thirds of the work, ten hours a week, including a thesis, if required, must be chosen in one department called the major department. The work in the major department is to be selected from the list of graduate studies. About one-third of the work is to be in another department, called the minor department, and may be chosen from the list of graduate studies or from other advanced courses offered by the University. The candidate is required to satisfy each professor concerned that he is fully competent to pursue the subjects selected.

Candidates may be enrolled at any period of the college year, but preferably at the beginning of the regular terms in September and February.

The fees for instruction are $100 a year for students in residence, and $50 a year for studies in non-residence, payable in advance (or as arranged with the Bursar's office). A student in residence who takes more than one year shall have returned to him a pro-rata part of his payment for the second, or other succeeding years, if he finishes in a fraction of that year. A student in non-residence shall pay for the first two years; no fee will be required for the third year, but succeeding years, if necessary and permitted by the Faculty, shall be paid for at the rate of $50 a year. The graduation fee of $10 is required of all students.

After passing examinations in the assigned studies, presenting a satisfactory thesis as evidence of ability to do original work, if

required by the professor concerned, and paying all required fees, the candidate will be recommended by the Faculty to the Trustees for the Master's degree appropriate to the course pursued.

Some of the University Extension Courses listed on page 122 are designated as graduate courses. As these are given late in the afternoon, or in the evening, or on Saturdays, they are especially adapted to teachers and others who are enrolled as graduate students in non-residence.

The following graduate studies are now offered by the University:

MATHEMATICS AND ASTRONOMY

Practical Astronomy

PROFESSOR THORNBURG, PROFESSOR OGBURN

The work embraces: (*a*) The study of instruments and methods used in the determination of time, latitude, longitude, and azimuth; (*b*) practical work in the observatory, securing facility in making and reducing observations. Two terms (5).

Differential Equations

PROFESSOR LAMBERT

The course in Differential Equations is based on Johnson's *Differential Equations* and Byerly's *Spherical Harmonics*. Collateral reading in the University Library is required. Two terms (3).

Analytic Mechanics

ASSISTANT PROFESSOR REYNOLDS

Elementary and Advanced Rigid Dynamics; Potential Functions, based on Love's *Theoretical Mechanics;* Williamson and Tarleton's *Dynamics;* and Routh's *Dynamics*. Two terms (3).

Differential Geometry

MR. KNEBELMAN

Parametic representation of plane and skew curves and surfaces, theory of contact, curvature, differential invariants, intrinsic equations, trajectories, equations of Cesaro, curvilinear coordinates, equations of Lamé.

Representation of one plane upon another, conformal and spherical representation, equations of Gauss and Godazzi, theory of applicability. Two terms (2).

ENGLISH

English Literature

PROFESSOR THAYER

An advanced course in branches which have not formed a part of the undergraduate work of the candidate, the details of which will be arranged after a personal conference. Two terms (5).

Anglo-Saxon

ASSISTANT PROFESSOR MESCHTER

Anglo-Saxon poetry and prose above the grade of undergraduate work, from both the literary and the historical point of view. Two terms (5).

English Philology

ASSISTANT PROFESSOR LUCH

An advanced course in the principles of Teutonic philology as applied to the origin and development of the English language. Two terms (5).

Sanskrit

PROFESSOR THAYER

Beginners' Course. Perry's *Primer*. Lanman's *Reader*. Whitney's *Grammar*. Two terms (5).

ECONOMICS AND HISTORY

Political Economy

PROFESSOR STEWART

This course embraces: (*a*) The rise and development of economic systems and economic thought; (*b*) the scope and method of political economy. Patten's *Development of English Thought* and the works of Keynes, Cohn and Ingram on Political Economy will be used. Two terms (5).

American History

PROFESSOR STEWART

An examination of the influence of the economic development of the Union upon the legal and political theories incorporated in the Constitution. Two terms (5).

Politics

PROFESSOR STEWART

The history of the attempt to treat in a systematic way the problems of political organization. Pollock's *History of the Science of Politics* and Sidgwick's *Elements of Politics*. Two terms (5).

LATIN

PROFESSOR BLAKE

An advanced course in the Latin language and literature. The course will be arranged with each candidate individually upon application. Two terms (5).

GREEK

Advanced courses, of which the following are specimens, will be arranged upon application.

Hellenistic Greek

PROFESSOR GOODWIN

Gospel of St. Mark, *Acts*, and selected *Epistles of the New Testament*. Thayer's *Lexicon*. Blass's *Grammar of New Testament Greek*. Patristic literature. Collateral reading. Selections from Lucian. Two terms (5).

Dramatic Poetry

PROFESSOR GOODWIN

Several plays of Aeschylus, Sophocles, Euripides, and Aristophanes. Aristotle's *Poetics*. Collateral reading. Two terms (5).

Greek Philosophy

PROFESSOR GOODWIN

Plato's *Republic* and other works. Aristotle, selections. Ritter and Preller's *Historia Philosophiae Graecae*. Zeller's *History of Greek Philosophy*, and other collateral reading. Two terms (5).

ELECTRICAL ENGINEERING

Theory of Alternating Currents and Alternating Current Machinery

PROFESSOR ESTY

This course is based upon the works of Arnold, Bedell and Crehore, Steinmetz, and Laurence. Two terms (4).

Electrical Design

PROFESSOR ESTY

This course consists of predeterminations by calculation of the characteristics, regulation and performance of electrical machinery. Analysis and use of designing constants. Design of special machines. Two terms (3).

Electric Traction

PROFESSOR ESTY, ASSOCIATE PROFESSOR SEYFERT

The development of an electric railway project. Design of station and distribution system. Operating characteristics of direct and alternating current railway motors. Predetermination of motor equipment and run curves for given schedules and traffic. Choice of system. Estimate of cost. Two terms (3).

Electrical Testing

PROFESSOR ESTY, ASSOCIATE PROFESSOR SEYFERT

Special experimental research in electrical engineering; tests of the magnetic properties of iron and steel; investigation of the series single-phase alternating current motor; leakage reactance of induction motors; regulation of alternators; polyphase testing; electric railway testing. Two terms (3).

Radio Communication

PROFESSOR ESTY, ASSOCIATE PROFESSOR SEYFERT, MR. ESHBACH

The theory underlying the various sending and receiving systems, and the propagation of electromagnetic waves, combined with experimental work in connection with the department's wireless equipment. Two terms (2).

METALLURGY

Thermo-Chemistry and Thermodynamics of the Metals

PROFESSOR RICHARDS, ASSISTANT PROFESSOR ROUSH, MR. BUTTS

A study of the melting points, vapor tensions, specific heats, and latent heats of fusion and of vaporization of the metals, from a practical and theoretical viewpoint; also, of the heats of formation of compounds of the metals, and the relation of these to atomic weights and other chemical and physical properties. Lectures and laboratory work. First term (5).

Thermo-Chemistry and Physics of Metallic Alloys

PROFESSOR RICHARDS, ASSISTANT PROFESSOR ROUSH, MR. BUTTS

A study of the physical and chemical properties of metallic alloys, their melting points, specific heats, latent heats of fusion, heats of formation and microscopic structure. Lectures and experimental work. Second term (5).

Electrometallurgy

PROFESSOR RICHARDS, ASSISTANT PROFESSOR ROUSH

A study of the conditions of deposition of metals and alloys in electrolysis, electrolytic separations, formation of metallic compounds by electrolysis, energy absorption in electrolysis. Lectures and laboratory work. First term (5).

MINING ENGINEERING

Methods of Mining Engineering

PROFESSOR ECKFELDT

The study of methods used in a given mining region, or in the production of a given class of mineral, with respect to conditions influencing choice of method and cost. Two terms (5).

Mining Plant

PROFESSOR ECKFELDT

The determination of the efficiency of mining machinery of given types under varying conditions. Two terms (5).

Ore Dressing Plant

ASSISTANT PROFESSOR BARTLETT

The study of certain operations incident to the dressing of ores or the preparation of coal. Determination of efficiency of machines and processes. Losses in dressing. Two terms (5).

GERMAN

PROFESSOR PALMER, ASSISTANT PROFESSOR MORE

Schiller's Life and Works. Lectures, reading and reports on assigned work. First and second terms (3).

Middle High German. Wright's *Middle High German Primer.* Bachmann's *Mittelhochdeutsches Lesebuch*, Nibelungenlied. First term (3).

Middle High German. Gudrun, Wolfram von Eschenbach, Gottfried von Strassburg, Walter von der Vogelweide. Lectures on Middle High German literature. Second term (3).

GEOLOGY

Geological Investigation

PROFESSOR MILLER

The investigation and study of the literature of some special geological problem. This will comprise field and laboratory work on some district in the vicinity of the University. A map of a limited area will be constructed, the microscopic character and general structural features of the rocks which are exposed will be investigated and a thesis or dissertation embodying these results will be presented. Preparation required will depend upon the nature of the problems to be studied. Two terms (4).

Economic Geology

PROFESSOR MILLER

Advanced work in ore deposits. Study of the literature and of the theories of ore deposition, together with detailed work on the type occurrences of some one of the metallic or non-metallic minerals. The student will be required to make a thorough investigation and report on some mining district with special regard to the origin of the ores and such commercial aspects of the deposits as may depend chiefly on the geology. Preparation required: 270 or 271. Two terms (6).

Petrography

ASSISTANT PROFESSOR TURNER

A critical study of recent advances in petrographic methods and nomenclature. Preparation of a detailed report on a selected problem. Preparation required: 267, 269, 271, 272, 274, 278, and 279. Second term (3).

Physiography

PROFESSOR MILLER

The detailed study of physiographic types and processes. Conferences, reports and thesis, with work in the laboratory and field. A training in elementary physiography (such as is described in 277) together with some knowledge of general geology is essential. Two terms (4).

Physical Crystallography

ASSISTANT PROFESSOR TURNER

An advanced course in the geometrical and physical properties of crystals, with special reference to the Goldschmidt methods of crystal measurement and projection. First term (4).

CIVIL ENGINEERING

Bridge Design

PROFESSOR MC KIBBEN

The theory of suspension and arched structures, with the preparation of general plans and estimates, and the economic comparison of different types. Two terms (4).

Testing of Materials

PROFESSOR MC KIBBEN

The properties of materials of construction, with special reference to inspection and testing. The student will conduct original

researches in the laboratory. The work on the unification of methods of testing done by the International Association for Testing Materials will receive detailed attention. Two terms (5).

Railroad Engineering

PROFESSOR WILSON

The economic location of railroads, as influenced by probable volume of traffic and cost of operation. A course based on Wellington's treatise, with detailed discussion of special cases. Two terms (2).

Sanitary Engineering

MR. PAYROW

The designing of reservoirs, tanks, and pipe lines for water supply systems, and of sewers and other appurtenances for sewerage systems. Inspection of existing plants, with reports thereon. Two terms (4).

BIOLOGY

Vertebrate Histogenesis and Organology

PROFESSOR HALL

Lectures, reading, and laboratory work. In the laboratory the development of a vertebrate will be carefully followed, tracing the history of the germ-layers, organs and tissues. The organology deals with the association of tissues to form organs. Preparation required: 292, 293, 294. First term (3).

PHILOSOPHY, PSYCHOLOGY AND EDUCATION

PROFESSOR HUGHES, ASSISTANT PROFESSOR DROWN

The following undergraduate courses may count towards an advanced degree provided additional work be taken in connection with them: History of Philosophy, ancient and modern, History of Education, Educational Psychology, Principles and Practice of Teaching, and Psychological Studies. More advanced courses in Psychology, Logic, Ethics and Metaphysics, may be outlined to meet the needs of competent students. The following is the course that commonly is followed by those who select Education as the major study: Educational Psychology, two year hours; School Administration, two year hours; Secondary Education, two year hours; Seminar in Education, with Thesis, four year hours. Most students in the field of Education find it convenient to avail themselves of the Extension Courses, which are listed on page 122.

Graduate Courses

PROFESSOR HUGHES

History of Philosophy, advanced course. Two terms (2).

Seminar in Philosophy. Two terms (2).

Educational Psychology. A. The relation to essential human needs of the several forms of culture—sport, art, the moral and religious consciousness, and the spirit of science. Their origin and development. One term (2). B. Psychological measurements and mental hygiene. One term (2).

Greek Education. One term (2).

ASSISTANT PROFESSOR BROWN

Educational Measurements. Investigations and reports. One term (2).

Secondary Education. Two terms (2).

School Administration. Two terms (2).

Seminar in Education. Two terms (2).

FRENCH

Literature

PROFESSOR FOX, ASSISTANT PROFESSOR TOOHY

An advanced course in French Literature. The course will be arranged with each candidate individually upon application. Two terms (5) or (10).

Language

A. Old French. Grammar. Easier texts. Chanson de Roland. First or second term (2) or (3).

B. Old French. Reading and explanation of texts. First or second term (2) or (3).

C. Romance Philology. Sound change. Word formation. First or second term (2) or (3).

D. Romance Philology. Syntax. First or second term (2) or (3).

CHEMISTRY

Advanced Industrial Chemistry

PROFESSOR ULLMANN, ASSISTANT PROFESSOR CHAMBERLIN

This course involves the study of some industry dependent upon chemical principles and consists of experimental and analytical work in the laboratories, inspection of manufacturing establishments, and study of the technical journals and other publications. Two terms (10).

Advanced Organic Chemistry

ASSOCIATE PROFESSOR BABASINIAN, ASSISTANT PROFESSOR COBB

This course consists of original investigations in organic chemistry. Two terms (10).

Advanced Analytical Chemistry

PROFESSOR ULLMANN, ASSOCIATE PROFESSOR DIEFENDERFER

Study and comparison of known methods of quantitative analysis and the development of new methods. Two terms (10).

Physical Chemistry

DR. DARBY

This course consists of original investigations in physical chemistry. Two terms (10).

PHYSICS

Theoretical Physics

PROFESSOR MAC NUTT, ASSISTANT PROFESSOR CHARLES

Elective courses are offered in the following subjects: (*a*) The Theory of Heat, based upon Preston's *Theory of Heat*, Buckingham's *Thermodynamics*, and Nernst's *Theoretical Chemistry;* (b) The Theory of Electricity and Magnetism, based upon Maxwell's Treatise, J. J. Thompson's *Recent Researches*, and *Conduction of Electricity Through Gases*, and Hertz's *Electric Waves;* (c) The Theory of Light, based upon Preston's *Theory of Light*, Drude's *Theory of Light*, Wood's *Physical Optics*, and Edser's *Light for Advanced Students*. First and second terms (3) to (5).

Physical Research

PROFESSOR MAC NUTT, ASSISTANT PROFESSOR WILY

Advanced students are given an opportunity to pursue experimental investigations in physics. First and second terms (2) to (4).

TUITION AND OTHER FEES

For students in the courses in Civil, Mechanical, Metallurgical, Mining, Electrical, and Chemical Engineering, Chemistry and Ship Construction and Marine Transportation, the tuition fee is $200 for the year or $120 for either term; for students in the College of Arts and Science and the College of Business Administration, $150

for the year or $90 for either term. The tuition for the subjects offered in the Summer term immediately following Commencement Day is $20. No charge is made for such subjects to students who have paid tuition for the previous year, provided the subjects in question are a scheduled part of the technical courses they are pursuing. A graduation fee of $10 is paid by all candidates for a degree. A registration fee of $10 is paid by each student yearly when he enrolls, which goes to the Athletic Association and entitles the student to admission to all athletic contests held by the University. This registration fee was imposed at the request of the student-body.

All fees are payable at the office of the Bursar in Drown Memorial Hall. Tuition fees are payable in two instalments, on the opening day of the college year in September, and on the first day of the second term in February. The first instalment is $120, or $90, according to the course, and the second $80, or $60. Application may be made for a return of part of the tuition fee when a student has formally withdrawn from the University after less than four weeks' attendance in either term, but the amount thus refunded will in no case exceed one-half of the last instalment paid.

Students who fail to pay tuition fees when due will be notified that their attendance at college exercises must be discontinued until payment is made.

EXPENSES

Books, stationery, and drawing instruments may be bought by students at low prices at the Supply Bureau in Drown Memorial Hall. For work in the laboratories, materials may be obtained from the University, students making a deposit at the opening of the term covering the value of the materials. The amounts of these deposits are given under the detailed statements of laboratory courses in the List of Studies.

The University affords residence and board for those desiring to live on the campus. Single rooms in the dormitories, where 174 students are domiciled, rent at $65 a year; suites of three or four rooms rent at $81 for each occupant.

Students may obtain table board at the College Commons. The rate for 1918-19 is $25 for thirty consecutive days, or $6.25

for a single week. Numerous private householders in the city offer rooms and board at moderate charge.

Necessary expenses for the collegiate year, clothing and traveling not included, are estimated at $500 in addition to tuition. This includes attendance at the required summer schools.

SITE

Bethlehem is situated at the junction of the Lehigh Valley, the New Jersey Central, and the Philadelphia and Reading Railroads. The university buildings are about a half-mile from the station. New York is eighty-six and Philadelphia fifty-seven miles distant.

BUILDINGS

PACKER HALL

Packer Hall, completed in 1869, is four stories in height, 215 feet long, and 60 feet wide. It is built of Potsdam sandstone in the English Gothic style of architecture, and occupies a commanding position, overlooking Bethlehem.

The department of Civil Engineering occupies the greater part of the first and second floors of Packer Hall. On the first floor are a lecture room, two recitation rooms, a large drawing hall, two instrument rooms, two offices and a library room, and a shop equipped with a small lathe and other tools for use in repairing surveying instruments. The instrument rooms contain seventeen transits, fourteen levels, a large geodetic theodolite, two plane tables, and other instruments for engineering field work. In the library room is an excellent collection of plans of engineering structures. On the second floor are two drawing rooms, three recitation rooms, an instrument room, a blue-print room, and offices.

On the third and fourth floors are to be found the offices and recitation rooms of the department of Mathematics and Astronomy.

The offices of the President, Vice-President, Secretary of the Faculty and Registrar are located on the second floor of Packer Hall.

THE CHEMICAL AND METALLURGICAL LABORATORIES

The Chemical and Metallurgical Laboratories are contained in a fire-proof sandstone building, 219 feet in length by 44 in width, with a wing.

In the Chemical department there are two principal stories and a basement. The upper floor is occupied by the quantitative and the qualitative chemical laboratories. These rooms are 22 feet in height, and are well lighted and ventilated. Laboratories for industrial chemistry and the supply room are also on this floor.

The first floor contains a large lecture room, a smaller lecture room, a recitation room, a chemical museum, and laboratories for organic, physical, and sanitary chemistry.

In the basement is a large laboratory for the furnace assay of ores and a well appointed laboratory for gas analysis; also rooms containing the apparatus for processes in industrial chemistry, steam engine and dynamo and motor installation, air pump for vacuum filtration, etc.

The Metallurgical department contains a lecture room, a blowpipe laboratory for class instruction in blowpipe analysis; a museum of metallurgical collections; a laboratory provided with a spectroscope, a simple and a polarizing microscope, two Le Chatelier microscopes complete with camera; a dry laboratory provided with furnaces for solid fuel and for gas, with natural draught and with blast, electric current for electrometallurgical experiments, and a wet laboratory for ordinary analytical work. Equipment is provided for laboratory work in metallurgy, in metallography, and particularly in electrometallurgy, consisting of working places for students, each equipped with gas, electric current and apparatus for various kinds of experimental work; and several new pyrometers, calorimeters, and furnaces have been added to the general equipment. These departments are therefore well arranged and equipped for the instruction of classes in the courses in metallurgy, electrometallurgy, and blowpipe analysis of the regular curriculum, and to afford facilities to students for familiarizing themselves with the methods of measurement and research empoyed in metallurgy and electrometallurgy, and for conducting original investigations in these departments of science.

THE PHYSICAL AND ELECTRICAL LABORATORY

The Physical and Electrical Engineering Laboratory is 240 feet long, 44 to 56 feet wide, and four stories high. The halls and stairways, the photometer rooms, and all apparatus rooms are of fire-proof construction. The remainder of the building is of heavy mill construction.

On the first floor are the Advanced Electrical Laboratory and shops of the Physics Department, the Senior and Junior dynamo laboratories, the shops and research room of the Electrical Engineering Department, and a storage battery room belonging jointly to the Departments of Physics and Electrical Engineering.

The dynamo laboratory for Senior students in the west wing is supplied with power from a 75-kilowatt rotary converter receiving current from the University power plant through two 30 kilowatt transformers. The dynamo laboratory equipment, which is being constantly increased, now includes the following apparatus: an 18-kilowatt double current generator, two direct current motor-generator units, one Lincoln variable speed motor, a 4-kilowatt Westinghouse two-phase rotary converter, a 10-kilowatt General Electric six-phase compound rotary converter, two direct connected units consisting of 7½-kilowatt six-phase General Electric alternators driven by 15-horse power Allis-Chalmers motors, one 20-kilowatt two- (or three) phase alternator built by the Department, a 35-kilowatt Westinghouse single-phase alternator, a 10-kilowatt composite wound alternator driven by a 15-horse power Crocker-Wheeler motor, a pair of 3-horse power direct connected series crane motors, three motor-generator sets converting from alternating to direct current, four polyphase induction motors ranging from 2-horse power to 7½-horse power, three types of single-phase inductor motors, two single-phase commutator motors, twenty-two transformers of from 1 to 15-kilowatts, including two 15-kilowatt Scott-connected transformers, a 5-kilowatt 66,000-volt testing transformer, a 6-light constant current transformer, a 30-ampere arc rectifier outfit complete, a General Electric oscillograph outfit, and a variety of instruments, including voltmeters, ammeters, watt-meters, rheostats, contact makers, frequency meters, dynamometers, condensers, and other apparatus.

The dynamo laboratory for Junior students on the first floor in the west wing contains the following apparatus: a 20-kilowatt Ferranti alternator driven by a direct current motor, two arc light machines, twenty arc lamps of various types, a Brackett cradle dynamometer, a Westinghouse two-phase rotary converter, a motor driven battery-booster set, several types of adjustable speed motors, and other motors for direct and alternating currents.

On the second floor are the offices of the Departments of Physics and of Electrical Engineering, two general apparatus rooms, a

large laboratory room for Physics, a large dynamo laboratory for Sophomore students in Electrical Engineering, and an Electrical Engineering reading room. The dynamo laboratory for Sophomore students in the west wing is equipped with twenty-seven direct current machines of various types, dynamotors and several types of automatic starters and auxiliary apparatus. Apparatus exemplifying the operation of telegraph, telephone, and wireless telegraph stations are here installed. The equipment in wireless telegraphy includes a 250-foot antenna, 5-kilowatt transformer, oscillation transformer, quenched gap, and several sets of receiving apparatus.

On the third floor are the lecture room, apparatus rooms and photometer rooms of the Department of Physics, and lecture room, recitation rooms, apparatus room, and drawing room of the Department of Electrical Engineering.

On the fourth floor are recitation rooms and two large laboratory rooms of the Department of Physics.

THE W. A. WILBUR ENGINEERING LABORATORY AND POWER HOUSE

The laboratory portion of this building was erected in 1902; in 1907 the original building was doubled in size, the addition containing the new heating and lighting plant of the University. The building is of sandstone, conforming in material to the adjacent Chemical and Physical Laboratories. It is 44 feet wide by 188 feet long, one story high in the boiler room, but with a raised engine room forming a second story at either end.

The boiler equipment of the laboratory consists of two water-tube boilers rated at about 100-horse power each, one of Babcock & Wilcox type, the other of Sterling make. In the heat and light plant there are three 250-horse power Sterling boilers, with room for a fourth unit of equal or greater capacity. Each section has its own set of feed pumps and other auxiliaries, in the arrangement of which special provision has been made for easily conducting performance tests. The laboratory boilers are connected to the chimney of the old boiler house, and have also an induced draft outfit. The chimney of the newer plant is of a radial brick construction, 125 feet high, and a forced draft equipment to be installed when need for increased capacity arises.

A coal-storage yard north of the building has room for a season's supply of coal, and a system of belt-conveyors and bucket-elevator

is provided for receiving coal, dumping it on storage pile, and conveying it into the boiler room as needed.

The engine room of the laboratory, 50 feet long, contains a vertical triple-expansion engine of 75-horse power, a 60-horse power compound two stage Ingersoll air compressor, a small tandem-compound yacht engine, a simple Ball engine direct connected to a 25-kilowatt Crocker-Wheeler generator, and a 5-horse power De Laval steam turbine. There is also a complete set of Westinghouse airbrake apparatus, with four freight car brakes. The airbrake pump and all the other small motors, including the feed and condenser pumps, are piped to the surface condensers beneath the engine room floor. There are two large condensers of 150 and 60-horse power capacity respectively, with smaller ones for the pumps and for special experiments. Besides the various engines there is a large belt dynamometer, apparatus for testing gauges, indicators, thermometers, steam calorimeters and other instruments, and for experiment on flow of steam, for testing injectors, etc. The exhaust system includes a Cochrane feed-water heater of 250-horse power capacity.

The engine room of the power house is 31 feet long, with concrete floor. The generating units now installed are of 50 and 100-kilowatt rating, and there is room for a third of larger size. Simple horizontal Ball engines are direct connected to General Electric alternating current generators, which furnish 60-cycle two-phase current at 2200 volts for transmission to the various distributing centers. An engine-driven and a motor-driven exciter, with the switchboard, complete the electrical equipment. The engines exhaust through a Cochrane heater, and the exhaust steam is discharged directly into the low-pressure system during the heating season.

The abandonment and dismantling of the old boiler plant rendered available for laboratory use a floor space 45 feet by 70 feet in the old boiler house. This now contains a 150-horse power suction gas producer for anthracite coal and is also used for apparatus and experiment in gas-power engineering and hydraulics, and for a number of the minor thermodynamic experiments with steam.

This building bears the name of W. A. Wilbur in grateful recognition of the work he has done for Lehigh University.

WILLIAMS HALL

Williams Hall was the donation of Dr. Edward H. Williams, jr., of the Class of '75, and was so named by the Trustees of the University not only in recognition of this gift but also of Dr. Williams' long continued and important service to the University as an alumnus and as Professor of Mining and Geology.

Williams Hall is 186 feet long by 70 feet wide and covers a ground area of over 12,000 square feet. One-half of the building is devoted to the Department of Mechanical Engineering and the other half to the Departments of Geology and Biology.

In the eastern end are located the recitation rooms, instructors' offices, drawing rooms, reference library, and store rooms of the Department of Mechanical Engineering, and in the basement rooms and apparatus are provided for laboratory work in experimental mechanics and engineering physics, such as the calibration of the measuring instruments used in Mechanical Engineering, the determination of the mechanical efficiencies of hoisting and other gear, and the testing of motors. In this section there are electric motors, a water motor, a 15-horse power centrifugal pump, hoists, blocks, jacks, and dynamometers of various kinds.

In the west end the Department of Geology has on the first floor two lecture rooms, two offices, library, mineralogical museum, and laboratory of petrology and petrography. The lecture rooms contain specimens of rocks and fossils and a collection of economic minerals and ores. The main lecture room is fitted with a stereopticon for illustrated lectures. The laboratory of petrography is provided with fifteen high-grade petrographic microscopes, and study collections of rocks and minerals. The collection of rocks contains over six thousand specimens from type regions in different parts of the world. The mineralogical museum contains many valuable collections representing all the prominent mineral localities of the world. In the basement are the mineralogical laboratory, the blow-pipe laboratory, a small chemical laboratory for analytical work, and a room fitted with apparatus run by a one-horse power motor for cutting thin sections of rock. On the second floor is the paleontological museum, which contains the fossil collections. On the third floor is a room fitted as an office and laboratory, containing a Goldschmidt's two-cycle goniometer and other apparatus for advanced work in crystallography.

On the third floor are located the drawing room and an office of the Mining Department, also well-equipped blue-print and dark

rooms and a photographic laboratory used jointly by the Departments of Mining and Geology.

The Department of Biology has its lecture room, office, reference library, laboratories, and store rooms on the second floor, and a large vivarium on the third floor. The laboratories of this Department are thoroughly equipped with collections, sections, microscopes, and necessary appliances.

Two students' rooms, used by the Mining and Geological Society and by the Mechanical Engineering Society, are located in the basement.

THE FRITZ ENGINEERING LABORATORY

The late John Fritz, of Bethlehem, known as the father of the steel industry in the United States, and a member of the Board of Trustees dating from the founding of the University, donated to the University the funds for the erection and thorough equipment of an engineering laboratory. The building was designed and erected in 1910 under the personal supervision of Mr. Fritz. It has been named by the Trustees "The Fritz Engineering Laboratory". The building is equipped with a general testing section for testing iron and steel, a cement and concrete section, and a hydraulic section. The equipment is used by the Civil Engineering Department in connection with courses in Strength of Materials, Hydraulics, and Cement. Any student in the University who has the proper preparation may receive instruction in this laboratory.

The building is of modern steel frame construction, 94 feet wide and 115 feet long, with the main central section 65 feet in height, and two side sections of lesser height. The external walls which enclose the steel frame are of cement brick lined on the inside with red brick. A traveling crane, of 10-ton capacity, operated by electricity, commands the entire central portion of the building in which the testing of large specimens is carried on.

The general testing section is equipped with an 800,000-pound Riehlé vertical screw testing machine, capable of testing columns 25 feet long or less, tensile specimens 20 feet long or less, and transverse specimens up to lengths of 30 feet; an Olsen universal testing machine of 300,000 pounds capacity; smaller machines for ordinary tension, compression, transverse and torsion tests; a cold-bend testing machine, and a small machine shop. The hydraulic section occupies the east end of the main room and is

equipped with various tanks, weirs, pumps and other apparatus for studying problems in Hydraulics. The cement and concrete section has one large room for the making and testing of specimens and one room for the storage of materials.

THE ECKLEY B. COXE MEMORIAL LABORATORY

The Eckley B. Coxe Mining Laboratory is situated south of Williams Hall and is of dressed sandstone. It is 100 feet long by 75 feet deep, one story high in front with a raised floor in the rear.

The main part of the building contains the Ore Dressing Laboratory, 40 feet by 70 feet; the west wing contains a chemical laboratory, an assay room, a balance room, and a sampling laboratory; the east wing contains the office, recitation room and an instrument room. A locker and wash room is located in the basement of the east wing.

The equipment for the main laboratory, most of which was made by the Allis-Chalmers Co., consists of a gyratory crusher, rolls, screens, jigs, Huntington mill, classifiers, concentrators (tables and vanner), gravity stamps, amalgamating plates, grinding pin, and cyanide plant, with the necessary apparatus including grizzly, elevators, feeders, sand-pumps, settling tanks, zinc boxes, filter press, dryers, crawls, blocks, and electric motors. The sampling laboratory contains a small jaw crusher, a small gyratory crusher, rolls, sample grinder, a magnetic separator, and a small air compressor.

The machinery is driven by seven separate motors, and any one part or all of it can be operated at will, permitting experimental studies and tests of individual machines or groups of machines, or of an entire process, as occasion may require. In this way the entire plant is made flexible and enables combinations of processes in order to determine the best possible method to pursue in the treatment of gold and silver ores, both free milling and sulphides, by amalgamation and cyanide processes, and of lead, copper, zinc, iron ores, etc., and of coals, by coarse and fine concentration.

Owing to the prominence which flotation methods have assumed in Ore Concentration, it has seemed advisable to equip a special department of the main laboratory for this work, and four types of testing machines have been installed, together with the necessary equipment of motors, etc., for their operation.

The following equipment, consisting of large and small size Ingersoll-Rand rock drills, Stoper and Jackhammer drills, an Ingersoll-Rand pick machine for coal mining, a Water-Leyner rock drill, a Sullivan hand-power diamond drill machine, and a Temple-Ingersoll electric-air drill, is housed in this building, also a full size mine car, a section track on steel ties and several sets of steel mine timbers.

This laboratory has been named by the Trustees of the University "The Eckley B. Coxe Mining Laboratory" in memory of Eckley B. Coxe, who was universally recognized as a pioneer and a leader in the profession of Mining Engineering in this country, an active friend and valued Trustee of the University from its early days until his death. The Engineering and Mining Laboratories of Lehigh University, bearing the names of John Fritz and Eckley B. Coxe, record the friendship and close association of these two great engineers in their life-time, and their active interest in Lehigh.

CHRISTMAS HALL

Christmas Hall has historic interest as the first building of Lehigh University. It was originally a church, which was purchased from the Moravian Congregation. In the earliest years of the University it contained a chapel, lecture rooms and students' dormitory. After Packer Hall was completed in 1868, Christmas Hall and Saucon Hall were utilized as students' dormitories and mess hall up to 1885. For many years thereafter Christmas Hall was used by the Departments of Latin, Greek and Modern Languages. Classes of the Lehigh Evening School now meet in this building.

The offices of the Secretary of the American Electrochemical Society are located in the west end of Christmas Hall.

SAUCON HALL

Extensive alterations to Saucon Hall were made in 1896, adapting it to the needs of the Department of English. It contains a study and a recitation room for each instructor, a lecture hall seating 200 persons, and a large room on the ground floor which has been fitted up for the use of the literary societies, with committee rooms adjoining.

COPPÉE HALL

Coppée Hall, formerly the Gymnasium, was completely renovated in 1913 to adapt it to the needs of the Department of Arts

and Science. On the first floor is a large lecture room, the office and recitation rooms of the Department of Economics, and accounting rooms for instruction in Business Administration. On the second floor are the offices and recitation rooms of the Departments of Latin, Greek, German, Romance Languages, Philosophy and Education. The Psychological Laboratory, also situated on the second floor, is equipped for elementary instruction and experimentation in the psychology of sense and movement. On the third floor are the library and seminar room of the Departments of Arts and Science, also a large room for a museum and art gallery.

The building has been named by the Trustees of the University "Coppée Hall" in memory of Henry Coppée, M.A., LL.D., the first President of the University, who served in that capacity from the establishment of the University in 1866 to 1874; he retained his active connection with the University as Professor of English Literature, International and Constitutional Law and the Philosophy of History up to his death in 1895.

SAYRE OBSERVATORY

By the liberality of the late Robert H. Sayre, one of the Trustees of the University, an Astronomical Observatory was erected on the University grounds, and placed under the charge of the Professor of Mathematics and Astronomy.

The Observatory contains an Equatorial Telescope by Alvin Clark, of six inches clear aperture and of eight feet focus; a Zenith Telescope, by Blunt; a Superior Astronomical Clock, by William Bond & Son; a Meridian Circle; a Prismatic Sextant, by Pistor and Martins; and an Engineer's Transit and a Sextant, by Buff and Buff.

Students in practical astronomy receive instruction in the use of the instruments and in observation.

The land upon which the Observatory stands, consisting of seven acres adjoining the original grant, was presented to the University by the late Charles Brodhead, of Bethlehem.

Sayre Observatory Annex

Sayre Observatory Annex contains a modern zenith telescope of four and one-half inches clear aperture equipped with electric illumination. The building and instruments were presented to the University by the late Robert H. Sayre, July 23, 1903.

Observations secured with this instrument are for the purpose of investigating the Variation of Latitude.

THE PACKER MEMORIAL CHURCH

The Packer Memorial Church, in which daily chapel exercises are held, was the munificent gift of the late Mrs. Mary Packer Cummings, daughter of the founder of the University. It was built in 1887 and is one of the largest churches in the State. During 1909-10 it was thoroughly renovated; the walls were newly frescoed, new stained glass windows put in place, and electric lights installed. These improvements were made possible by the continued generosity of the donor, Mrs. Cummings.

THE UNIVERSITY LIBRARY

The Library building was erected by the founder of the University in 1877, at a cost of $100,000, as a memorial to his daughter, Mrs. Lucy Packer Linderman.

The building is semi-circular with a façade in the Venetian style of architecture. It is constructed of Potsdam sandstone with granite ornamentation. In the interior there is a reading room 40 by 50 feet from which radiate book cases extending from floor to ceiling; two galleries afford access to the upper cases. Shelf room is provided for one hundred and sixty thousand volumes. One hundred and forty-four thousand volumes are now upon the shelves. The list of periodicals numbers about four hundred.

The Library is open from 8 A.M. to 6 P.M., except Sundays and holidays.

The free use of the Library, with the privilege of taking out books, is offered to students of every department on presentation of their registration cards. The use of the books and of the periodicals within the building is free to all persons. Resident graduates of the University have the full use of the Library on payment of three dollars annually. Persons pursuing systematic investigation in any study may be allowed the free use of the Library for a period not exceeding three months without fee. At the discretion of the Director, a deposit may be required when books are issued.

The Eckley B. Coxe Memorial Library

In memory of Eckley B. Coxe, who was for many years a Trustee of the University and who was profoundly interested in its welfare, Mrs. Coxe presented to the University his technical library, consisting of 7727 volumes, together with 3429 pamphlets. As the working library of a man who was remarkable as well for the breadth of his culture as for the extent and thoroughness of his

acquaintance with the whole field of applied science, this addition to the resources of the University possesses the greatest value for all professional students.

TAYLOR HALL

Taylor Hall, the gift of Mr. Andrew Carnegie, is a commodious concrete dormitory situated in the University Park, south of Packer Hall. It accommodates about 140 students. There are suites of three rooms, (a study and two adjacent bed rooms,) for two occupants, and a few single rooms. The building was named Taylor Hall by Mr. Carnegie in honor of Mr. Chas. L. Taylor, his former partner in business, a graduate of the University in the Class of 1876 and a Trustee of the University. The rates for the suites of rooms are $81 a year for each occupant. The single rooms are $65 a year.

PRICE HALL

Price Hall furnishes dormitory accommodations for thirty-four students. It was named in honor of Dr. Henry R. Price, an alumnus of the University of the Class of 1870, President of the Board of Trustees.

Application for rooms in the dormitories should be filed with the Bursar.

DROWN MEMORIAL HALL

Drown Memorial Hall is a memorial to the late Thomas Messinger Drown, LL.D., President of the University from 1895 to 1904. The building was erected by his friends and the Alumni of the University and is devoted to the social interests of the University students. It contains study, reading, conversation, and chess rooms, an assembly hall, and the offices of the Alumni Association, the Young Men's Christian Association, the college publications, the dramatic and musical organizations. It also accommodates the Supply Bureau, conducted by the University, the purpose of which is to furnish books, stationery and supplies to the students at reasonable prices. The profits of the Supply Bureau are applied to the upkeep of Drown Memorial Hall.

The office of the Bursar is in Drown Memorial Hall.

THE COLLEGE COMMONS

The Commons were erected in 1907 to furnish a place where students might obtain wholesome food at cost. There are accommodations for four hundred students. The present rates for table

board are $25 for thirty consecutive days, or $6.25 for a single week.

TAYLOR GYMNASIUM

In 1913 Mr. Chas. L. Taylor, a graduate of the University of the Class of 1876 and a member of the Board of Trustees, donated to the University the funds required for the erection of a gymnasium and a field house.

Taylor Gymnasium is located at the extreme east end of the grounds of the University, adjoining the Athletic Field. The building is 222 feet long by 73 feet wide. On the ground floor at the north end is located the game-room, 93 by 70 feet, used for basketball and wrestling. The game-room is surrounded by a gallery for spectators. The main gymnasium floor measures 90 by 70 feet. Other rooms in Taylor Gymnasium are the offices and measuring room of the Department of Physical Education, a large trophy room, basketball and handball courts, fencing, boxing and wrestling rooms, and locker rooms with accommodations for the entire student-body.

The Gymnasium is equipped with all modern appliances for recreative and corrective exercises, also with apparatus for calisthenic and other gymnastics, both for individual and for class work.

In addition to numerous hot and cold shower baths, adjoining the locker rooms, is a swimming pool, 75 by 25 feet, with a depth from 4½ to 9½ feet. The capacity of the swimming pool is 95,000 gallons.

TAYLOR FIELD

An athletic field of over nine acres in area is provided by the University for the accommodation of students who participate in the various outdoor sports. The stadium is located on the north side, or lower level, and provides football and baseball fields. It is surrounded by concrete stands having a seating capacity for more than 12,000 spectators. On the upper level are provided practice fields for football, baseball, lacrosse and soccer, also a quarter mile track and a 220-yard straightaway, furnishing ample room for exercise by the entire student-body. During the winter months a wooden outdoor running track, twelve laps to the mile, is provided.

A Cage with 60 by 120 feet floor space is provided for indoor baseball, lacrosse, and track and field sports practice.

All athletic sports are under the direction and oversight of the Professor of Physical Education, who is aided by an Athletic Committee composed of Alumni and students, members of the Faculty, a member of the Board of Trustees, and the President of the University.

SAYRE PARK

A development of the mountain side of the University grounds was effected through the donation to the University in 1900 of the sum of $100,000 by the children of the late Robert H. Sayre to be applied and used in the development of Sayre Park as a memorial to their father. Mr. Sayre was a Trustee of the University from its foundation in 1866 to his death in 1907. He acted for years as President of the Board of Trustees, and as Chairman of the Executive Committee of the Board, and his services to Lehigh were constant and great.

THE ARBORETUM

The Arboretum, a tract of about eleven acres added in 1909 to the upper end of Sayre Park, was established by a lover of Forestry and a friend of the University as a tree nursery for the purpose of furnishing illustrative specimens of American trees, and of cultivating trees and shrubs for the beautifying of the Park. All of the more important species of North American trees are to be found in the University Park and the Arboretum. Adjoining the Arboretum a tract of seven acres has been planted with a variety of indigenous trees as an exhibition growth of tree culture.

DIPLOMAS AND CERTIFICATES

The Diploma is given to those who have fulfilled the requirements of regular courses. For all partial courses a certificate is given, showing what the student has accomplished.

THE UNIVERSITY MUSEUMS

The University Museums include large collections illustrating various branches of Chemistry, Metallurgy, Geology, Mineralogy, Zoölogy and Archæology.

The Metallurgical Cabinet includes specimens illustrating the various processes for obtaining the more common metals.

The Zoölogical collections include the Packer collection of recent shells and the Werner collection of American birds. The

latter contains over three hundred and fifty species. In most cases, in addition to the adults, specimens in different plumages as well as the nests and eggs are represented.

The Geological and Mineralogical Museums are located in the west end of Williams Hall, and contain the Roepper and Keim mineral collections, collections of fossils, specimens of ore from mining districts, and extensive series of rocks which illustrate the type occurrences in different parts of the world.

The Cummings Archæological Cabinet has three thousand specimens and includes Dr. Stubb's collection of Indian relics, weapons, and utensils.

UNIVERSITY LECTURES

From time to time during the University year, distinguished men are invited to lecture before the students upon those special subjects to which they have given particular attention and upon which they are authorities.

HONORARY SCHOLARSHIP SOCIETIES

PHI BETA KAPPA. Students in the College of Arts and Science who up to the middle of the Senior year maintain high scholarship may be elected to membership, also a limited number of technical students whose work in philosophical, scientific, and language studies is of high grade.

TAU BETA PI. Students in engineering courses who up to the middle of the Junior year maintain high scholarship may be elected to membership.

THE CHEMICAL SOCIETY

The Chemical Society was organized in the fall of 1871.

The collections of botanical and zoölogical specimens belonging to the Society are important. During past years persons have been sent to Texas and Brazil to collect specimens for these cabinets.

THE ENGINEERING SOCIETIES

The original Engineering Society was organized in 1873 and was open to all technical students of the University. From 1885 to 1890 it issued quarterly five volumes of "The Journal of the Engineering Society of Lehigh University," containing contributions by the members, alumni, and others. Many of the papers

read before this Society from 1890 to 1893 were published in the former "Lehigh Quarterly."

In 1900 the Civil Engineering and Mechanical Engineering students formed independent societies. The Electrical Engineering Society, founded in 1887, was reorganized in 1901. Later the Metallurgical Society and the Mining and Geological Society were formed. All these Societies hold monthly meetings for the reading and discussion of papers relating to the subjects of their particular departments.

THE ARTS AND SCIENCE CLUB

The Arts and Science Club was organized in the fall of 1905. Its object is to supplement the routine class-room work of the courses in Arts and Science by the reading and discussion of papers on topics of varied interest. Discussions are led from time to time by members of the Faculty and addresses are made by scholars from outside the University. Students in all the courses of the University are eligible for membership.

THE CHINESE CLUB OF LEHIGH UNIVERSITY

The Chinese Club was organized in November, 1909, by the Chinese students of the University for literary purposes and the mutual profit of its members.

THE Y. M. C. A. OF THE UNIVERSITY

The Christian Association is a voluntary organization of the students for the promotion of the religious, moral, and social life of the University. It was organized April 18, 1890, and on October 11, 1890, united itself with the Intercollegiate Young Men's Christian Association. The movement is distinctly for and by students, all the officers, with the exception of the General Secretary, being chosen from the student-body.

FOUNDER'S DAY

On the first Saturday of October of each year, Commemorative Exercises are held in honor of the founder of the University. Because of the influenza quarantine, these exercises were omitted in 1918.

PUBLIC WORSHIP

Morning Prayers are held in the Packer Memorial Church of the University, at which attendance is required.

UNIVERSITY SERMON

The University sermon is preached on Sunday in University Week. The Rt. Rev. Thomas Frank Gailor, D.D., Bishop of Tennessee, was the preacher on Sunday, April 14, 1918, in the Packer Memorial Church.

HONOR SYSTEM

The Honor System is in force at Lehigh University, having been adopted by the unanimous action of the student-body.

THESES

Theses when required deal with some topic connected with the course from which a student is to graduate, as a necessary portion of the exercises for his final examination for a degree. These theses are accompanied by drawings and diagrams, whenever the subjects need such illustration. The originals are kept by the University, as a part of the student's record, for future reference, but a copy may be retained by the student, and be published, permission being first obtained from the Faculty.

UNIVERSITY DAY

This day is ordinarily the last of the academic year. On this day orations are delivered by members of the graduating class and degrees are conferred. In 1918, due to war conditions, University day was held on April 13.

EXERCISES ON APRIL 13, 1918

MUSIC

PRAYER

ALUMNI ADDRESS

ARTHUR E. MEAKER, C.E., '75, M.S., '18.

ANNOUNCEMENT OF SENIOR HONORS

Arts and Science Courses

First: JACOB ARIEL BISHOP, of Chambersburg.

Second: CHARLES ALBERT WOLBACH, of Riegelsville.

Civil Engineering Course

First: LEON HAROLD SCHNERR, of Peckville.

Mechanical Engineering Course

First: JAY PHAON CLYMER, of Lebanon.

Second: WALTER RAYMOND PENMAN, of Hazleton.

Degrees in course were then conferred by the President of the University upon the following:

MASTER OF ARTS

RALPH ACHILLES MAUTONE, B.A., B.D.,
(*Wesleyan University, Drew Theological Seminary*), Reading.

MASTER OF SCIENCE

KWANG CHIANG YUNG, E.M.,
(*Colorado School of Mines*), Szechuen, China.

BACHELOR OF ARTS

WILLIAM GREGORY BARTHOLD,	Bethlehem.
BENJAMIN BENNES,	Newark, N. J.
JACOB ARIEL BISHOP,	Chambersburg.
EDWARD THOMAS CORRIGAN,	Philadelphia.
LEON APPLE FRITCHMAN,	Freemansburg.
HAROLD EDWIN O'NEILL,	Altoona.
KARL LAWRENCE RITTER,	Bethlehem.
CHARLES ALBERT WOLBACH,	Riegelsville.

BACHELOR OF SCIENCE

JOSEPH SELDON GOODMAN,	Bethlehem.
ALFRED SCHULTZ SCHULTZ,	Palm.
MARVIN REINHARD SOLT,	Northampton.

CIVIL ENGINEER

JESSE PAUL AMBLER,	Philadelphia.
PAUL GLOSE BREINIG,	Allentown.
ROBERT HENRY BRINTON,	Oxford.
GEORGE APPLETON BUTTERWORTH,	Harrisburg.
ROBERT LEWIS CREER,	Philadelphia.
SAMUEL BOYD DOWNEY,	York.
HAROLD SPENCER HUTCHINSON,	Flushing, N. Y.
JAMES BAIRD JACOB,	Louisville, Ky.
JOHN MCCHESNEY LATIMER,	Washington, D. C.
JAMES EARL MINNICH,	Robesonia.
ANSEL LIEBERKNECHT PURPLE,	Columbia.
HENRY NILS ROEST,	Bethlehem.
HERBERT DEAN ROOT,	Elizabethtown.
LEON HAROLD SCHNERR,	Peckville.
JOHN SHERMAN,	Roanoke, Va.
JOHN HENRY SWANGER,	Lebanon.

Albert Paul Treser,	New Castle.
Chiang Hsien Wang,	Tientsin, China.
Paul Rodman Wilford,	Bangor.

MECHANICAL ENGINEER

Fred Jacob Beckmann,	Hellertown.
Joseph Franklin Carlz,	Winthrop, Mass.
Jay Phaon Clymer,	Lebanon.
Nestor Dmytrow,	New York, N. Y.
Allen Judson Ely,	Red Bank, N. J.
John Webb Hogg,	Washington, D. C.
Alan Creighton Hoover,	Weatherly.
Lloyd Gladstone Jenkins,	Drifton.
Edgar Lewis Klotz,	Davenport, Cal.
Walter Raymond Penman,	Hazleton.
Hugh Jackson Phillips, jr.,	Washington, D. C.
Ralph Raymond Reed,	Orwigsburg.
Ray Mantz Stettler,	Slatington.
Edward Hanlon Zollinger,	Harrisburg.

ELECTROMETALLURGIST

Richard Champney Alden,	Steelton.
Charles Essen Blasius,	Philadelphia.
Morton Joseph Kay,	Harrisburg.
Harold Diefenderfer Lehr,	Bethlehem.
William Tobias Mitman,	Bethlehem.

ENGINEER OF MINES

Shu Choe,	Talifu, China.
John Constine,	Wilkes-Barre.
Francis Williams Hukill,	Middletown, Del.
Meredith Esrey Johnson,	Bethlehem.
Maynard Mizel,	Brooklyn, N. Y.
Leonard Sargeant, 3rd,	Washington, D. C.
William Essen Tizard,	Philadelphia.

ELECTRICAL ENGINEER

Roscoe Dimond Bean,	Bethlehem.
George Ralph Lawall,	Allentown.
Russell Hess Lindsay,	Harrisburg.
Cheng-Chi Lu,	Canton, China.
Homer Isaac Moll,	Strausstown.
Norman Ralph Munkelwitz,	Sayville, N. Y.

BACHELOR OF SCIENCE IN CHEMISTRY

John Joseph Early,	Campello, Mass.
Carl Oscar Lind,	Campello, Mass.

CHEMICAL ENGINEER

Frederick Winchell Bickley,	Newark, N. J.
Harold Gilbert Boyd,	Scranton.
Andrew Edward Buchanan, jr.,	Harrisburg.
Shao Lieh Chang,	Shanghai, China.
John McKay,	Philadelphia.
Walter Michelle Maccalum,	Phoenixville.
Martin Alphonsus Morrissey,	South Boston, Mass.
Chienton Chenlatt Woo,	Fukien, China.

As a part of the exercises of University Day, the following honorary degree was conferred:

Master of Science

Arthur E. Meaker, C.E., '75,	Binghamton, N. Y.

Since University Day and within the calendar year the following, having completed their courses, have been awarded their degrees and are entitled to be enrolled in the Class of 1918:

Louis Burros, Ch.E.,	Scranton.
Jose Manuel Carbonell, E.M.,	Barranquilla, Columbia.
Sherman Daniel Chambers, B.S., M.S. (*Baldwin-Wallace College*), C.E.,	Bethlehem.
Elmer Harold Flinn, El.Met.,	Philadelphia.
Edwin Higgins, E.M., M.S., (*Lehigh University*),	San Francisco, Cal.
Charles Maxwell Alton Lebowitz, Ch.E.,	Scranton.
William Thomas Staats, C.E.,	Philadelphia.

PRIZES AWARDED MAY 18, 1918

The Wilbur Scholarship of $200 to
Wilbur Reinoehl Heck, of Ocean Grove, N. J.

The John B. Carson Prize, for the best thesis in the Civil Engineering Department—No award.

The Alumni Prizes of $25, for first honor men in the Junior Class in various departments,
Civil Engineering—No award.
Mechanical Engineering—No award.

The Price Prize of $25 for English Composition, open to members of the Freshman Class, was awarded to

ALLEN JENNINGS BARTHOLD, of Bethlehem.

Honorable mention:

ROBERT DOMINICK BILLINGER, of Shenandoah.

The Wilbur Prizes of $10 for excellence in the studies of the Sophomore year were awarded as follows:

In Mathematics, to

JOHN HERMAN SPALDING, of Pottsville.

In English, to

FREDERICK GARNER MACAROW, of Hazleton.

In Physics, to

ROBERT JOSEPH OTT, of Bethlehem.

The Wilbur Prizes of $15 and $10, for excellence in the studies of the Freshman year, were awarded as follows:

In Mathematics, to

First: CARL RICHARD BERNER, of Pottsville.

Second: SAMUEL LOUIS FLOM, of Northampton.

In English, to

ROBERT DOMINICK BILLINGER, of Shenandoah.

In German, to

CHARLES RUSSELL WOLFE, of Asbury Park, N. J.

In French, to

JOHN HERBERT ALDEN, of Washington, D. C.

HONOR LIST

JUNIOR HONORS

Arts and Science Courses

First: HAROLD SPRAGUE HILLER, Buchanan, Mich.

Electrical Engineering Course

First: EDWARD THOMAS PETRIK, Baltimore, Md.

Mining Engineering Course

First: HSIUNG TSAI, Hu-chow, Chekiang, China.

Chemistry and Chemical Engineering Courses

First: HOWARD DAVID GINDER, Scranton.

Second: HAROLD DEWITT SMITH, Bayonne, N. J.

SOPHOMORE HONORS

In Mathematics

First: JOHN HERMAN SPALDING, of Pottsville.

Second: ROBERT JOSEPH OTT, of Bethlehem.

In English

First: FREDERICK GARNER MACAROW, of Hazleton.

Second: DEWEY ZIRKIN, of Washington, D. C.

In Physics

First: ROBERT JOSEPH OTT, of Bethlehem.

Second: WILBUR REINOEHL HECK, of Ocean Grove, N. J.

Third: JULIUS HERMAN SPALDING, of Pottsville.

FRESHMAN HONORS

In Mathematics

First: CARL RICHARD BERNER, of Pottsville.

Second: SAMUEL LOUIS FLOM, of Northampton.

In English

ROBERT DOMINICK BILLINGER, of Shenandoah.

In German

CHARLES RUSSELL WOLFE, of Asbury Park, N. J.

In French

JOHN HERBERT ALDEN, of Washington, D. C.

VOCATIONAL COURSES FOR SOLDIERS

During the spring of 1918 the Committee on Education and Special Training of the War Department requested Lehigh University to establish special courses for the vocational training of soldiers. The plan of the Government involved combined military and scholastic training for periods of approximately eight weeks each of men voluntarily inducted into the service through their local draft boards. Regular army officers assigned to the University had charge of military drill and discipline. The University was charged with providing scholastic instruction, board and lodging of the soldiers. Three detachments were assigned to Lehigh University for periods running approximately from May 15 to July 15, from July 15 to September 15, and from September 15 to November 15, respectively.

The baseball cage was remodeled to serve as barracks for the soldiers. One of the athletic fields of the University served as drill grounds and the University Commons was the mess hall.

Part of the University gymnasium was also used during the summer for housing soldier-students.

The Lehigh University detachments were assigned to the following vocational courses: telegraphy, electric trades, concrete work, road construction, railroad track work, locomotive engineering, locomotive firing, battery mechanics and cooking. The content of each course is indicated by its name. As far as possible the outlines suggested by the Federal Board for Vocational Training were followed explicitly.

With the hearty cooperation of the officials of the Philadelphia and Reading Railway Company, arrangements were made to have the air brake instruction car of that company and a locomotive of the type used by the American Expeditionary Force in France sent to Bethlehem, in charge of the regular air brake instructor of the Philadelphia and Reading Railway Company. Students in Locomotive Engineering and Locomotive Firing were given instruction in driving locomotives, including actual practice on trains run on the lines of the Philadelphia and Reading Railway Company, supplemented by class room instruction in boilers and locomotives by members of the department of Mechanical Engineering. As far as possible men with former experience as firemen were assigned to the course in Locomotive Engineering.

The course in Battery Mechanics was arranged through the courtesy of the officials of the Bethlehem Steel Company. During the eight weeks of instruction each student assigned to this course had two weeks each in four different shops of the Bethlehem Steel Company, where he participated in all stages of the manufacture of guns of different types and sizes, particular emphasis being placed upon finishing, adjusting, and assembling of parts. As far as possible, men with previous experience as mechanicians were assigned to that course.

Valuable aid was given in the course in telegraphy by the Western Union Telegraph Company, and in railroad track work by the Lehigh Valley Railroad Company.

Courses of instruction in these vocational subjects were started at Lehigh University on May 8, 1918. The final detachment left on December 4, 1918. During this time instruction was given to 1151 soldiers.

Certificates of satisfactory completion of these special courses were issued under seal of the University.

STUDENTS' ARMY TRAINING CORPS

A unit of the Students' Army Training Corps was established at Lehigh University on October 1, 1918, and was continued until December 11, 1918. The unit included 468 students in the Army section and 71 in the Navy section.

In the summer of 1918 the University announced, as a war measure, three-year intensive courses in all departments, effective September, 1918. Upon the establishment of the Students' Army Training Corps in October, 1918, the three-year courses were discontinued. On January 6, 1919, the regular four-year courses were resumed.

THE WILBUR SCHOLARSHIP

The Wilbur Scholarship was founded in 1872 by the late E. P. Wilbur and is the sum of $200 awarded annually to the student in the Sophomore Class having the best record.

THE HARRY S. HAINES MEMORIAL SCHOLARSHIP

Mrs. Henry S. Haines, of Savannah, Georgia, established in 1889 a scholarship of the annual value of $200 as a memorial to her son, Henry Stevens Haines, M.E., a member of the Class of 1887. This scholarship is devoted to the support at Lehigh University, throughout his scholastic career, of one student in the School of Mechanical Engineering.

THE FRED. MERCUR MEMORIAL FUND SCHOLARSHIPS

Friends of the late Frederick Mercur, of Wilkes-Barre, Pennsylvania, General Manager of the Lehigh Valley Coal Company, desiring to establish a memorial of their friendship and esteem, and to perpetuate his memory, contributed and placed in the hands of the Trustees a fund called "The Fred. Mercur Memorial Fund," sufficient in amount to insure the award of three scholarships for free tuition in the University.

THE DU PONT SCHOLARSHIP

In June, 1918, E. I. duPont de Nemours and Company, for the purpose of encouraging the study of Chemistry, offered a scholarship of $350 for the scholastic year 1918-1919 to be awarded to a senior student or graduate student in the Department of Chemistry and Chemical Engineering. This scholarship was awarded

by the Faculty to Howard David Ginder, of Scranton, Pennsylvania, a member of the class of 1919.

THE JOSEPH MANN PRICKITT SCHOLARSHIP

Mr. and Mrs. Cooper H. Prickitt, of Burlington, N. J., established, in April, 1919, a scholarship, to be known as the Joseph Mann Prickitt Scholarship, in memory of their son, Joseph Mann Prickitt, of the Class of 1917, who died on March 10, 1916.

This scholarship is of sufficient amount to cover expenses for tuition, fees and books. It is the expressed wish of the donors that the scholarship be awarded to graduates of the Burlington, N. J., High School on the nomination of the Principal of that school, subject to the approval of the President of the University, or in case of no nomination from that school that the award be made to deserving students from other localities. This scholarship will first be awarded in September, 1919.

THE ECKLEY B. COXE MEMORIAL FUND

In memory of the late Eckley B. Coxe, Trustee of the University, Mrs. Coxe has established a fund, amounting to $30,000, the interest of which is used, under the direction of the Trustees of the University, and subject to such regulations as they may adopt, for the assistance of worthy and needy students requiring financial aid.

THE FRANK WILLIAMS FUND

Frank Williams, E.M., of Johnstown, Pennsylvania, a graduate of the course in Mining and Metallurgy of the Class of 1887, who died October, 1900, bequeathed to the University the greater part of his estate, now amounting to over $120,000, to found a fund, the income of which is lent to deserving students. At present the larger part of this income is devoted to certain life tenants under Mr. Williams' will. After their death the entire income will be available.

WILBUR PRIZES

A fund was established by the late E. P. Wilbur for distribution in prizes as the Faculty shall determine. This fund yields an annual income of $100.

THE PRICE PRIZE FOR ENGLISH COMPOSITION

Dr. Henry R. Price, an Alumnus and Trustee of the University, established in 1898 an annual prize of the value of $25, to be awarded in June to that member of the Freshman Class who shall write the best essay on a topic in English Literature assigned by the head of the Department of English not later than the beginning of the second term in each year.

In estimating the value of essays submitted, the greatest stress will be laid upon clearness of thought and force of expression.

Students must signify in writing their intention of competing not later than the first of April.

The subject for the prize essay in June, 1919, will be: "Philip Freneau, the Poet of the Revolution."

THE JOHN B. CARSON PRIZE

An annual prize of $50 was established in 1909 by Mrs. Helen C. Turner, of Philadelphia, Pennsylvania, in memory of her father, John B. Carson, whose son, James D. Carson, was a graduate of the Civil Engineering Department of Lehigh University in 1876. It is awarded for the best thesis in the Civil Engineering Department.

THE ALUMNI ASSOCIATION

The Alumni Association, which has been in existence since 1876, was incorporated in 1917 under the name The Alumni Association of the Lehigh University, Inc. The Alumni Secretary, who devotes all of his time to Association affairs, is Walter R. Okeson, '96, whose offices are in Drown Memorial Hall. Mr. Okeson edits the *Lehigh Alumni Bulletin*, a quarterly news publication, and the *Alumni and Student List*. An appointment bureau is maintained by the Association.

ALUMNI PRIZES

By a resolution of the Alumni Association of September 21, 1900, the Alumni Scholarship Fund, which was originally designed to help poor students, was with the consent of the contributors diverted from this purpose and the income devoted to prizes to members of the Junior Class. In June, 1919, two prizes of $25 each will be awarded to the first honor men of the courses in Metallurgy, Electrometallurgy and Mining Engineering and of the course in Electrical Engineering. In subsequent years the prizes

will be awarded to the first honor men of the other technical courses in turn.

ALUMNI PRIZE FOR ORATORY

The Alumni Association of Lehigh University established in 1882 annual prizes for excellence in oratory, amounting to $50.

Regulations

1. The contest shall be held on the 22d day of February, or on the day designated by the University to commemorate the birthday of Washington.

2. There shall be a first prize of $25, a second prize of $15, and a third prize of $10.

3. To entitle one to be a competitor he must be a member of the Junior Class, taking a regular course.

4. Subjects for the orations shall be announced at the beginning of the first term of every year, and upon one of these each competitor shall write an oration not to exceed 1200 words, taking about eight minutes in delivery.

5. Each oration shall bear upon its first page a fictitious name or motto, and shall be accompanied by a sealed envelope, which shall be superscribed with the same name or motto, and an address by which it may be reclaimed. The envelope shall contain the real name and address of the writer, with the declaration that the oration is his own original work. The examiner, having adopted a standard of excellence, may reject any or all of the orations presented which do not attain to this standard; of such as do—should they be sufficient in number—the best six shall be chosen, and their envelopes opened. The others shall be returned to the addresses given with their envelopes unopened.

6. The Executive Committee of the Alumni Association, or a committee of not fewer than three to be appointed by them, shall hear the competitors whose orations shall have been approved, and the awards shall be made by a majority of these judges.

7. In awarding the prizes the judges shall consider both the literary merits and the delivery of each oration.

8. These rules are subject to amendment by the Faculty.

The annual contest in Oratory for the Alumni Prizes was held on February 22, 1918, with the following competitors:

Howard David Ginder, of Scranton.

William Alfred Kreidler, of Bethlehem.

James David Sourber, of Pottsville.

Hsiung Tsai, of Hu-chow, Chekiang, China.

The first prize was awarded to Mr. Tsai; the second to Mr. Kreidler, and the third to Mr. Sourber. A fourth special prize was awarded to Mr. Ginder.

The Judges were Robert S. Taylor, B.S., '95; Walter R. Okeson, C.E., '96, and Prof. Howard Eckfeldt, B.S., '95, E.M., '96.

WILLIAMS PRIZES IN ENGLISH

Professor Edward H. Williams, jr., an alumnus of the University, a graduate of the Class of 1875, established in February, 1900, prizes amounting annually to three hundred and thirty-five dollars for excellence in English Composition and Oratory. The conditions of the endowment are as follows:

Sophomore Composition Prizes

1. At the beginning of each term the Sophomore Class shall be divided into two sections alphabetically and to that student in each section who, at the end of a term, and of each term, shall receive the highest rank in English Composition during that term shall be awarded the "First Sophomore Composition Prize" of ten dollars, and to that student in each section as aforesaid who shall receive the next highest rank in the same subject shall be awarded the "Second Sophomore Composition Prize" of five dollars. In each year there will be offered four first and four second prizes—a total of sixty dollars.

If more than one student shall receive the highest rank in any section, the amount of the two prizes shall be added together and the sum—fifteen dollars—shall be equally divided between them, and no second prize shall be offered in that section. If more than one student shall receive the next highest rank in any section when there is but one contestant for the first prize, the second prize shall be equally divided between the two having the second rank.

Senior Premiums

2. The Faculty shall publish within one month of the end of the University year a list of subjects for dissertations, selected from English Literature and Economics, entitled Subjects for Senior Premiums. To this list shall be appended a date near the first of January following—to be determined upon by the Faculty —when the contest shall be declared closed and the dissertations shall become due.

From the above list any member of the Senior Class may select a subject and write thereon a dissertation, whose length shall be prescribed by the Faculty, and shall send the same anonymously, but marked for identification, as the Faculty may direct, to the Secretary of the Faculty before the date aforesaid.

The Faculty, or its committee, shall meet on the above date and at subsequent adjourned meetings, and, first, having determined upon a standard of excellence which each and all dissertations must reach in order to be admitted to the following competition, shall examine the dissertations submitted to them and admit those which reach the above standard. In case none are up to the standard, and are admitted they shall declare the contest closed for that year, and no prizes shall be awarded.

If one or more dissertations are admitted as aforesaid, the Faculty, or its committee, shall arrange them in the order of their literary merit and soundness of their reasoning, and the six highest in this arrangement shall be retained and all others returned as directed by the writers, who shall remain unknown. The names of the successful writers shall be ascertained and they shall be required to recast their dissertations in the form of an oration, and to speak the same in public at such time during the Commencement Week as the Faculty shall determine.

The Faculty, or its committee, shall be the judges of excellence in the speaking, and shall award to that Senior student who shall speak his oration in the best manner, the Senior Gold Medal, of the value of one hundred dollars, or, at his option, one hundred dollars in gold. They shall award to the other five speakers the five Senior Premiums of ten dollars each.

Graduate Prize

3. At the end of the University year, during Commencement Week, the Faculty shall publish a second list of subjects for theses selected from English Literature, Economics, Mental and Moral Science, and similar subjects which require thought and application, and which must be of such a character that their mastery shall be accomplished only through considerable research and study.

From this list any member of the class just graduating; the Senior Class of the coming University year; a graduate of one year's standing whether in or out of residence, and a graduate of any class who may be, during the coming year, in actual residence

and taking post-graduate work in the University, may select a subject and write thereon a thesis of not less than five thousand words and send the same to the Secretary of the Faculty, anonymously, but marked for identification as the Faculty may designate, before the date, which the Faculty shall select within one month before the next Commencement, and which date must appear on the above list.

The Faculty, or its committee, shall meet on this date, and at adjourned meetings thereafter, and, having first established a standard of excellence, which must, first, be a high one, and second, shall require on the part of the competitor ability in the plan, development, argument, and conclusion of the work, as well as literary merit in its composition and presentation, shall admit to the following competition only those who fully attain to the above required standard.

If none of the theses submitted shall have attained to the standard aforesaid, the competition shall be declared closed and the prize shall not be awarded.

To the author of that thesis which shall have been admitted to the competition, and which shall have been declared of the highest excellence, the Graduate Prize of one hundred and twenty-five dollars shall be awarded and presented on Commencement Day with the other prizes and awards of that day.

The successful thesis shall be the property of the University, but the author shall be allowed to retain one copy. Publication of the thesis by the author will only be permitted by vote of the Faculty. Such publication must, however, be entitled Graduate Prize Thesis of the Lehigh University.

The winner of a prize shall not be allowed to compete again.

Professor Williams has directed that the income derived from the endowment for the Williams Prizes shall be applied and used as follows:

1. All portions of said income remaining after the payment of all prizes awarded in any one year, shall be invested and added to the principal of said endowment.

2. If any prize shall, for any reason, be not awarded in any year, the sum thus unpaid shall be invested and added to the said principal.

3. If for any reason the amount of the income from said endowment shall fall below the total sum necessary to pay said prizes,

the amounts of the individual prizes shall be proportionally reduced till their sum shall be equal to three-fourths of the said reduced income, and this three-fourths shall be used to pay them; the remaining one-fourth is to be invested and added to the said principal.

4. This investment of residues, as above said, shall continue till the principal of said endowment shall be sufficiently large to furnish an income at two per cent. interest, which will be sufficient to pay all said prizes now established.

5. When said principal shall be large enough to furnish the necessary sum to defray the said prizes, as stated in No. 4, the surplus income remaining after paying all the prizes awarded during the year shall be used by the President of the University to encourage oratory, debate, or any other object decided upon by the Faculty.

THE FRAZIER AND RINGER MEMORIAL FUND

This is a fund for the medical and surgical care of needy students, established in memory of Benjamin West Frazier, A.M., Sc.D., formerly Professor of Mineralogy and Metallurgy, and Severin Ringer, U.J.D., formerly Professor of Modern Languages and Literatures and of History, each of whom faithfully served Lehigh University for one-third of a century. The fund was started February 12, 1906, by the donation of thirteen thousand dollars by the late Robert H. Sayre. It is the hope and expectation of the friends of the University that this fund may, by other donations, be increased in time to amount to a sum sufficient to insure free medical and surgical attendance to all students of the University requiring such aid.

STUDENTS

(A)—S.A.T.C. at Lehigh University.
(B)—Naval Unit at Lehigh University.
(C)—Returned from Service in U. S. A.
(D)—Returned from Service in U. S. N.
(E)—Withdrew to enter Service in U. S. A.
B.A.—Bachelor of Arts.
B.S.—Bachelor of Science.
Biol.—B.S. in Biology.
Bus.—Business Administration.
C.E.—Civil Engineering.
Ch.E.—Chemical Engineering.
Chem.—Chemistry.
E.E.—Electrical Engineering.
E.M.—Mining Engineering.
El.Met.—Electrometallurgy.
Geol.—B.S. in Geology.
Math.—B.S. in Mathematics and Physics.
M.E.—Mechanical Engineering.
Met.—Metallurgical Engineering.
N.E.—Ship Construction and Marine Transportation.

GRADUATE STUDENTS

The names in the following lists include all the students who have registered and attended recitations at the University for the current year.

	For Degree	Residence
Allam, LeRoy Sterner, B.A., (*Moravian College.*)	M.A.,	Bethlehem.
Allen, Paul Jonathan, B.A., (*Moravian College.*)	M.A.,	Washington, D. C.
Appel, Howard Frederick, Met., (*Lehigh University.*)	M.S.,	Everett.
Barthold, William Gregory, B.A., (*Lehigh University.*)	M.A.,	Bethlehem.
Beck, George Carlton, A.C., (*Lehigh University.*)	M.S.,	Bethlehem.
Boston, Henry Robert, B.S., C.E., (*College of City of New York, Lehigh University.*)	M.S.,	New York, N. Y.
Buck, Leonard Jerome, E.M., (*Lehigh University.*)	M.S.,	Bethlehem.
Burke, James Michael, B.S., (*Lehigh University.*)	M.S.,	Akron, Ohio.
Callen, Arthur Spencer, El.Met., (*Lehigh University.*)	M.S.,	Florence, Ala.
Chamberlin, Dale S., Ch.E., (*University of Michigan.*)	M.S.,	Bethlehem.

Clemmitt, Willis Butler, E.M., M.S., Chicago, Ill.
(*Lehigh University.*)
Crowley, Henry L., B.S., M.E., M.S., Indian Head, Md.
(*College of City of New York, Stevens Institute of Technology.*)
DeBaufre, William Lane, E.E., M.S., Annapolis, Md.
M.E., (*Lehigh University.*)
Diefenderfer, Herbert H., B.S., M.S., South Amboy, N. J.
(*Pennsylvania State College.*)
Everhart, William Alfred, B.A., M.S., Bethlehem.
(*Miami University.*)
Fraim, Parke Benjamin, E.M., M.S., Bethlehem.
(*Lehigh University.*)
Glasier, J. Arthur, B.D., M.A., Bethlehem.
(*General Theological Seminary.*)
Grubb, Percy Lamar, B.A., M.A., Harrisburg.
(*Lehigh University.*)
Ham, Frank Mapes, B.S., M.S., Bethlehem.
(*Wesleyan University.*)
Hartzell, Allen Reiff, B.S., M.S., Bethlehem.
(*Franklin and Marshall College.*)
Higgins, Emerson Corson, jr., M.S., Tulsa, Okla.
B.S., (*Lehigh University.*)
Horine, Frederic Laurent, B.S., M.S., Marcus Hook.
(*Lehigh University.*)
Hutchinson, R. Thomas, B.S., M.S., Bethlehem.
(*Muhlenberg College.*)
Jacobosky, Gilbert Garfield, C.E., M.S., Wilkes-Barre.
(*Lehigh University.*)
Jacobs, Homer Miller, Ph.B., M.A., Easton.
(*Lafayette College.*)
King, Robert Charles, B.A., M.A., Bethlehem.
(*University of Missouri.*)
Lindsay, A. M., B.A., M.A., Harrisburg.
(*Lebanon Valley College.*)
Linn, Tsin I., E.M., M.S., Lansford.
(*Lehigh University.*)
Lottenville, Marie, A.B., M.A., Bethlehem.
(*Indiana State University.*)
Marcks, Frederick Augustus, M.A., Nazareth.
B.A., (*Muhlenberg College.*)

Martin, Robert E., A.B., (*University of Indiana.*)	M.S.,	Bethlehem.
Murai, Ichiro, B.S., (*Tokyo Imperial University.*)	M.S.,	Port Arthur, China.
Oswald, Gustavus Eugene, B.A., (*Ursinus College.*)	M.A.,	Catasauqua.
Rex, Barron P., Ph.B., (*Lafayette College.*)	M.S.,	Bethlehem.
Ringleben, August A., A.B., (*Ursinus College.*)	M.A.,	Hazleton.
Schwaninger, Mary Alice, A.B., (*Western Maryland College.*)	M.A.,	Allentown.
Shedd, Thomas C., Sc.B., (*Brown University.*)	M.S.,	Phoenixville.
Snyder, Harry C., Ph.D., (*Muhlenberg College.*)	M.A.,	Emaus.
Strunk, Elvira M., B.S., (*Albright College.*)	M.S.,	Changsha, Hunan, China.
Taylor, Robert Norman, Ph.B., (*Muhlenberg College.*)	M.S.,	Bethlehem.
Toohy, John Milton, B.A., (*Lehigh University.*)	M.A.,	Bethlehem.
Urich, Robert R., B.A., (*Muhlenberg College.*)	M.A.,	Nazareth.
Vicente, Manuel Lucas, C.E., (*Lehigh University.*)	M.S.,	Mayaguez, P. R.
Ward, Arthur Thomas, El.Met., (*Lehigh University.*)	M.S.,	Bellefonte.
Wentz, Herbert Homer, B.S., (*Muhlenberg College.*)	M.S.,	Allentown.
Yano, Masayoshi, E.E., (*Tokyo Institute of Technology.*)	M.S.,	Usenji, Japan.

Bishop, Jacob Ariel, B.A., (*Lehigh University.*)	M.E.,	Chambersburg.
Carmany, Russell Bender, B.A., (*Albright College.*)	Bus.,	Myerstown.
Duck, Francis John George, F.S.A) (*St. Thomas College.*)	Ch.E.,	Scranton.

Grossman, Lazer, Ph.B., (A) C.E., Allentown.
(*Muhlenberg College.*)
Huebner, Richard Victor, B.S., Bus., Allentown.
(*Pennsylvania Military College.*)
Lees, James Knox, B.A., (A) C.E., Bethlehem.
(*Lehigh University.*)
Ruperti, Justus Oscar, B.A., El.Met., New York, N. Y.
(*Williams College.*)
Sussman, Joseph Baruch, A.B., C.E., Allentown.
(*Muhlenberg College.*)
Tyree, James Leigh, B.A., (A) Ch.E., Durham, N. C.
(*Trinity College, N. C.*)

Maccallum, Walter Michelle, Spl. Bus., Phoenixville.
Ch.E., (*Lehigh University.*)
Shannon, Spencer Sweet, A.B., Spl. E.M., Saxton.
(*University of Pennsylvania.*)
Uihlein, Ralph Alfred, B.Ph. Spl. El.Met., Milwaukee, Wis.
(*Yale University.*)

SENIOR CLASS

Class of 1919

	Course	Residence
Amick, Walter Park, (A)	M.E.,	Philadelphia.
Baumann, Lewis Albert, (A)	Ch.E.,	Washington, D. C.
Bevier, Kenneth Miller,	Bus.,	Brooklyn, N. Y.
Botero, Baltasar,	E.M.,	Sanson, Colombia.
Brockman, Charles Joseph, (C)	B.A.,	Nazareth.
Buckley, Malcolm Kee,	Chem.,	Allentown.
Bull, Hempstead Stratton, (A)	E.E.,	Fairbury, Ill.
Carbonell, José Manuel,	E.M.,	Barranquilla, Colombia.
Cardin, Carl John,	M.E.,	North Brookfield, Mass.
Coffin, Roy Riddell, (D)	Bus.,	Germantown.
Concilio, August, (C)	E.E.,	Newton, N. J.
DeVout, Anson Wolfinger, (B)	M.E.,	Harrisburg.
Diefenderfer, Wilbur Frederic, (C)	M.E.,	Allentown.
Doan, Gilbert Everett, (A)	Ch.E.,	Lansdale.

Dorkin, David, (B)	M.E.,	Bridgeport, Conn.
Engle, Artemus Bertine, (A)	Met.,	Bethlehem.
Fenstermacher, Lloyd Carroll, (C)	Geol.,	Reading.
Ganter, George A., (A) (C)	E.M.,	New York, N. Y.
Gardiner, Joseph Wilkins, jr.,	Ch.E.,	Philadelphia.
Geis, Leonard Bailey,	E.M.,	Philadelphia.
Gerber, Ivan Preston, (A)	Ch.E.,	York.
Gilman, Charles Grafley, (A)	E.M.,	Philadelphia.
Ginder, Howard David, (A)	Ch.E.,	Scranton.
Gonzales, Fernando,	C.E.,	Torreon, Mexico.
Gorisse, Curtis Buttz, (C)	C.E.,	Lebanon, N. J.
Hartney, Edwin Adams,	B.A.,	Allentown.
Haussmann, Alfred Carl, (A)	B.A.,	Fox Chase.
Hesselschwerdt, Fred Henry,	Ch.E.,	Buffalo, N. Y.
Hiller, Harold Sprague, (A)	B.A.,	Buchanan, Mich.
Hunt, Clarkson Toms,	M.E.,	Lansdowne.
Iobst, Edgar Henry, (A)	C.E.,	Emaus.
Johnson, Ralph Franklin, (C)	C.E.,	Washington, D. C.
Keifer, Boyd Ernest,	M.E.,	Bethlehem.
Keim, Rollin Reuben, (A)	Ch.E.,	Bethlehem.
Korves, Albert Anthony, (B)	E.M.,	Bethlehem.
Lauder, Beeton Pullman, (C)	M.E.,	Bridgeport, Conn.
Lawrence, Morris,	Ch.E.,	Scranton.
Lewis, Levi Roy, (C)	M.E.,	Clarks Summit.
Ludlow, Raymond Woodruff, (A)	Bus.,	Keansburg, N. J.
McGalliard, David Cubberley,	E.E.,	Trenton, N. J.
McGrath, Philip Lawrence, (C)	Bus.,	West Roxbury, Mass.
McKinley, William Bradley,	B.A.,	Olyphant.
Manley, Milton Augustus, (B)	Bus.,	Brooklyn, N. Y.
Mayers, Augustus Greth, (C)	Ch.E.,	Reading.
Mertz, Charles Dorney,	M.E.,	Frackville.
Mitman, Samuel Thomas, (C)	M.E.,	Bethlehem.
Mora, Arnobio Bernardo,	E.M.,	Loja, Ecuador.
Mooers, Edward Allen, (C)	Ch.E.,	Elmira, N. Y.
Nawrath, Frederick Dent,	Ch.E.,	Newark, N. J.
Nicholas, Andrew John, (A)	M.E.,	Bethlehem.
O'Neill, Thomas Carson, jr., (A)	E.M.,	Altoona.
Petrik, Edward Thomas, (B)	E.E.,	Baltimore, Md.
Reynolds, Nelson Roy, (C)	M.E.,	Bethlehem.
Rigg, Benjamin Haines, (A)	C.E.,	Burlington, N. J.

Rosenbaum, Robert, (A) (E)	Geol.,	Philadelphia.
Rowand, Ellwood Montgomery, jr., (B)	M.E.,	Haddon Heights, N. J.
deSa, Angelo,	M.E.,	Bahia, Brazil.
Sefing, Frederic George, (A)	El.Met.,	Allentown.
Smith, Harold DeWitt, (C)	Ch.E.,	Bayonne, N. J.
Sourber, James David, (C)	B.A.,	Pottsville.
Speakman, Franklin Baily,	Ch.E.,	Strathmere, N. J.
Spillman, Otto Henry, (A)	C.E.,	Bethlehem.
Sun, To Shuen,	El.Met.,	Anhui, China.
Tomkinson, Charles Hoyt,	M.E.,	Plainfield, N. J.
Tomlinson, Charles Nicholas Wheaton, (B)	E.M.,	Aurora, Ill.
Tsai, Hsiung,	E.M.,	Hu-chow, Chekiang, China.
Vance, Stratton,	E.M.,	Port Washington, N. Y.
Wagner, John Harold,	C.E.,	Harrisburg.
Wait, Edgar Fritz, (D)	M.E.,	Bethlehem.
Walters, Harold Rodman, (A)	B.A.,	Bethlehem.
Webb, Samuel Hancock,	M.E.,	Jamaica, L. I., N. Y.
Weber, George Esch,	C.E.,	Ardmore, Okla.
Whitney, Edward Foote, (A)	M.E.,	Sherburne, N. Y.
Woolley, Walter Ray, (A)	El.Met.,	Asbury Park, N. J.
Zeller, Theodore Cyril, (A)	B.A.,	McKeesport.

JUNIOR CLASS

Class of 1920

	Course	Residence
Allgaier, William Raymond, (A)	C.E.,	Philadelphia.
Armstrong, Morris Simpson, (A)	E.E.,	Red Bank, N. J.
Baderschneider, Engelbert Henry,	M.E.,	Monongahela.
Barthol, Preston Clayton,	Bus.,	Bethlehem.
Bassett, Joseph Yarnall, (A)	C.E.,	Coatesville.
Baver, David Ezra, (A) (C)	E.E.,	Shoemakersville.
Beck, William Andrew, jr., (A) (C)	B.A.,	Englewood, N. J.
Bell, John Gordon, (A) (C)	Met.,	Canton, O.
Bell, Samuel Kneale, (B)	Ch.E.,	Germantown.
Bellman, Russell Sylvester, (D)	M.E.,	Louisville, Ky.
Bergdoll, John George, jr., (A)	M.E.,	York.

Booth, Edwin, (B)	C.E.,	Carbondale.
Boyd, Kenneth Watson, (A) (E)	Ch.E.,	Washington, D. C.
Brooks, Maxwell Jacobs, (A)	El.Met.,	Niagara Falls, N. Y.
Brown, Robert Emerson, (C)	Met.,	Butler.
Bugbee, Alvin Newton,	C.E.,	Trenton, N. J.
Bunn, Howard Stolpp, (A)	B.A.,	Elkins Park.
Burnes, William Ryan, (A) (E)	Bus.,	Port Chester, N. Y.
Buss, Russell Shimer, (A)	E.E.,	Bethlehem.
Butz, Louis Neuweiler,	El.Met.,	Allentown.
Carr, William Arthur, (C)	M.E.,	Washington, D. C.
Coleman, Joseph Mathias, (B)	Ch.E.,	Steelton.
Cope, Robert Schwartz, (A)	B.A.,	Bethlehem.
Croce, Gennero S. Della, (A)	El.Met.,	Freeland.
Culler, Roy Lester, (A)	M.E.,	Harrisburg.
Danzer, Russell William Herbert, (B)	M.E.,	Bethlehem.
Davidson, Beale Bordley, (D)	Ch.E.,	Elizabeth, N. J.
Davies, Herbert Arthur, jr., (A)	Ch.E.,	Paterson, N. J.
Dewhirst, Harold Hodgkins, (C)	C.E.,	Washington, D. C.
Diener, Fred Peter, (A)	Ch.E.,	Allentown.
Dittes, Norman Cyrus Smith, (A)	B.A.,	Wyomissing.
Dorsam, William Christian, (A)	El.Met.,	Brooklyn, N. Y.
Erwin, George Henry, (A)	Ch.E.,	Bethlehem.
Estes, Edward Wynne, (A)	M.E.,	Bethlehem.
Evans, Arthur Randolph, (A)	M.E.,	Middletown.
Ewing, Boyd Ross, jr., (A)	B.A.,	Allison Park.
Farber, Hobart Amory, (A)	B.A.,	Northampton.
Forstall, Edward Logan, (A)	M.E.,	Rosemont.
Freixas, Juan, (A)	M.E.,	Rio Grande, P. R.
Ganey, James Cullen, (B)	B.A.,	Bethlehem.
Gardy, Jacob Allen, (C)	Bus.,	Doylestown.
Geiger, Joseph Lewis, (B)	M.E.,	Scarletts Mills.
George, Darcy Matthew, (A)	E.E.,	Nazareth.
Gilmore, Dale James, (C)	B.A.,	Williamsport.
Gonzales, Eduardo,	M.E.,	Torreon, Mexico.
Goodell, Charles Graham, (A)	C.E.,	Frederick, Md.
Greenstein, Philip David, (A)	Ch.E.,	Bridgeport, Conn.
Grubbs, Richard Holmes, (A) (C)	C.E.,	Baltimore, Md.

Hammond, Philip Conrad, (A)	C.E.,	Bridgeport, Conn.
Harwi, Lawrence Hartman, (A)	Bus.,	Bayonne, N. J.
Heck, Wilbur Reinoehl, (A)	E.M.,	Ocean Grove, N. J.
Heffelfinger, Roy Harold, (C)	Chem.,	Palmerton.
Heilman, John Beaver,	El.Met.,	Lebanon.
Heimbach, Eugene Dewey, (A)	M.E.,	Renovo.
Herman, Joseph,	E.E.,	Northampton.
Heuchel, Harry John, (D)	Met.,	Brooklyn, N. Y.
Hills, Philip Randolph, (A)	B.A.,	Mill Hall.
Hoffman, Solomon,	E.E.,	Baltimore, Md.
Hollinshead, Earl Darnell, (C)	E.M.,	Medford, N. J.
Honeyman, Robert Brodhead,	Met.,	Brooklyn, N. Y.
Hunton, William Hoppe, (A)	Ch.E.,	Philadelphia.
Ilyus, Edmund Burwell, (A) (E)	E.E.,	Lancaster.
Jenness, Edward Hutchins, (B)	M.E.,	Chicago, Ill.
Karton, Harry, (B)	Ch.E.,	Philadelphia.
Ketcham, Burton Tilden, (B)	B.A.,	Huntington, N. Y.
King, Walter Cornelius,	Ch.E.,	Bethlehem.
Knerr, Ralph Johnson, (A)	M.E.,	Claussville.
Knerr, William James, (A)	El.Met.,	Allentown.
Koan, Koam Tsing,	Ch.E.,	Bangkok, Siam.
Kuhlmann, August Max, (A)	El.Met.,	Washington, D. C.
LeRoy, Milton Joseph, (A)	El.Met.,	Syracuse, N. Y.
Levy, Harry G., (A)	C.E.,	Hazleton.
LeWine, Oscar Ezra, (B)	C.E.,	Atlantic City, N. J.
Lewis, Randolph Osgood, (A)	M.E.,	Washington, D. C.
Long, Henry Laurence, (A)	Ch.E.,	York.
McCarthy, John Donald, (D)	E.M.,	Bethlehem.
Macarow, Frederick Garner, (A)	E.E.,	Hazleton.
Maginnes, William David, (D)	Biol.,	New York, N. Y.
March, Walter Stockley, jr., (C)	E.M.,	Cynwyd.
Mathag, Nathan, (A)	E.M.,	New Haven, Conn.
Memmert, Paul William, (A)	Ch.E.,	Nazareth.
Mersfelder, John Henry, jr., (A)	Ch.E.,	Newark, N. J.
*Middleton, Howard Ware, (A)	M.E.,	Philadelphia.
Mieldazis, Jerome John, (C)	C.E.,	Shenandoah.
Miller, Frank William, (C)	C.E.,	Reading.
Munoz, Audato Laurence Lorenzo,	M.E.,	Santa Barbara, Honduras.
Muth, Edgar Franklin, (A)	M.E.,	Northampton.
Naame, Joseph Shikri, (A)	C.E.,	Atlantic City, N. J.

*Died March, 1919.

Nevins, Benjamin Ross,	E.E.,	Tamaqua.
Newell, Norman Albert, (A)	E.E.,	Allentown, N. J.
Obert, Joseph Geggus,	Bus.,	Lehighton.
Ostrolenk, Samuel, (A)	E.E.,	Canby, Minn.
Ott, Robert Joseph, (A)	M.E.,	Bethlehem.
Overton, Sereno Burnell,	M.E.,	Southampton, N. Y.
Paret, Milnor Peck, jr., (C)	C.E.,	Lake Charles, La.
Pawlik, Benjamin Adolph J., (A)	E.M.,	Union Hill, N. J.
Pengelly, Thomas Stanley, (C)	Bus.,	Hazleton.
Perry, Robert Swain, jr., (A)	Ch.E.,	New York, N. Y.
Raiguel, Jackson Bornman,	Ch.E.,	Glenside.
Reinhardt, Joseph Alfred, (C)	C.E.,	Brooklyn, N. Y.
Rice, Harry Charles, (A)	Ch.E.,	Hazleton.
Romig, Clarence James, (A)	E.M.,	Allentown.
Rosenmiller, Joseph Lewis, (B)	E.M.,	York.
Ruf, Leonard Edward, (C)	C.E.,	Philadelphia.
Savadkin, Solomon S.,	C.E.,	Scranton.
Saxman, Harry Suydam, (B)	E.M.,	Latrobe.
Schlasman, William Henry, (A)	M.E.,	Reading.
Schuessler, William John, (B)	C.E.,	Philadelphia.
Schulz, Donald deVantier, (A) (E)	Met.,	Bethlehem.
Scott, George Stanley,	Ch.E.,	East Mauch Chunk.
Shafer, Alfred Elwood Morton, (A)	M.E.,	Lehighton.
Shipherd, John Jay, (D)	Ch.E.,	Evansville, Ind.
Siegfried, Joseph Albert, (A)	E.E.,	Nazareth.
Smoyer, Lloyd Moser, (B)	E.E.,	Allentown.
Sommers, Howard Greenwald, (A)	Ch.E.,	Allentown.
Spagna, Joseph,	C.E.,	Avon, Mass.
Spalding, Julius Herman, (A)	M.E.,	Pottsville.
Spillman, Arnold Dolder, (B)	El.Met.,	Bethlehem.
Steinmueller, William August jr., (A)	C.E.,	Bethlehem.
Stotz, Edward, jr., (D)	C.E.,	Pittsburgh.
Straub, James Moser,	C.E.,	Canonsburg.
Straub, Theodore Frederick, (E)	C.E.,	Fort Adams, R. I.
Subkow, Philip, (A)	Ch.E.,	Bethlehem.
Sugar, Aaron Jesse, (A)	Ch.E.,	Norfolk, Va.
Tate, Mercer Brown, jr., (C)	B.A.,	Harrisburg.

Terry, John Hermon, Jr., (B)	Ch.E.,	Edgewater Park, N. J.
Terry, Walter Septer, (A)	M.E.,	Holtsville, N. Y.
Thomas, Ross Raymond, (C)	M.E.,	Hammonton, N. J.
Thompson, James Stanley, (A)	Ch.E.,	Warehouse Point, Conn.
Timmons, John Irving, (A)	C.E.,	Snow Hill, Md.
Townsend, Stanley Coleman, (A)	E.E.,	Malvern.
Tseng, Yin Lian,	E.M.,	Blinjoe, Banka, Dutch East Indies.
Wagener, August H., (A)	C.E.,	Ellicott City, Md.
Weishaupt, Robert Charles, (A)	M.E.,	Lancaster.
Wensk, Joseph Anthony, (A)	E.E.,	Baltimore, Md.
Wey, Howard Lee, (A)	E.M.,	Bristol, Conn.
Wick, Albert James, (A)	E.E.,	Washington, D. C.
Wiegner, William Kruse, (B)	E.E.,	Bethlehem.
Wildman, George Andrew,	E.E.,	Bridgeport, Conn.
Wilson, Albert Henry, jr.,	C.E.,	East Orange, N. J.
Wolfe, Marmaduke Revenaugh, (A)	El.Met.,	New York, N. Y.
Wuerz, Oscar William, (A)	Ch.E.,	New York, N. Y.
Wysocki, de Victor, jr., (A)	El.Met.,	Asbury Park, N. J.
Yard, Charles Frederick, (C)	C.E.,	Trenton, N. J.

SOPHOMORE CLASS

Class of 1921

	Course	Residence
Albertson, Nicholas Arthur, (A)	C.E.,	Atlantic City, N. J.
Alden, John Herbert, (A)	El.Met.,	Washington, D. C.
Arnheimer, Leonard, (C)	Ch.E.,	New York, N. Y.
Arthur, James Martin, (D)	Math.,	Cranford, N. J.
Barrett, Harold George, (B)	Bus.,	Leominster, Mass.
Barthold, Allen Jennings, (A)	B.A.,	Bethlehem.
Bashoar, Karl Ward, (B)	Met.,	Millersburg.
Berger, Milton, (A)	C.E.,	Atlantic City, N. J.
Berner, Carl Richard, (A)	C.E.,	Pottsville.
Bertolet, John Lorah, (C)	Ch.E.,	Reading.
Bichow, Solomon Charles, (A)	Ch.E.,	Baltimore, Md.
Billinger, Robert Dominick, (C)	Ch.E.,	Shenandoah.
Blake, Robert Dayton,	B.A.,	Bethlehem.
Bowden, Edmund Warren (C)	C.E.,	Camden, N. J.
Blom, Gustav Maurice, (A)	C.E.,	Butztown.

Bowman, Nelson Blair, (B)	E.M.,	Brownsville.
Boynton, Henry Gaines, (A)	Bus.,	New York, N. Y.
Brady, Harry Kidwell, jr., (A)	Met.,	Pittsburgh.
Brodnax, William Frederick, jr., (A)	M.E.,	Bethlehem.
Bump, Richard Lee,	C.E.,	Bridgeport, Conn.
Burgess, Eugene Willard, (B)	Bus.,	Joliet, Ill.
Burgess, Milton Valentine (A)	M.E.,	Connellsville.
Caplan, Samuel, (A)	Ch.E.,	Washington, D. C.
Carey, James Stark, (C)	Ch.E.,	Harrisburg.
Carpenter, Clinton Grier, (A)	Ch.E.,	Brooklyn, N. Y.
Chen, Chi-fah,	E.M.,	Amoy, China.
Childs, George Lawton, (A)	Bus.,	New York, N. Y.
Childs, Raymond Austin, (B)	Bus.,	New York, N. Y.
Chou, Smie Kwei,	M.E.,	Patung, Hupeh, China.
Christman, Frederick Mertz, (A)	Ch.E.,	Reading.
Christman, LeRoy Fisher,	C.E.,	Womelsdorf.
Clark, Gerald Hunt, (A)	B.A.,	Andover, N. J.
Clarke, David Messer, (A)	C.E.,	Philadelphia.
Claxton, Edmund, (D)	Ch.E.,	Bethlehem.
Comey, Paul VanAmringe, (C)	Ch.E.,	Wenonah, N. J.
Coppersmith, Edward Adolph, (A)	M.E.,	Egypt.
Crane, Montgomery, (B)	Biol.,	New York, N. Y.
Davis, Guild Darwin, (A)	M.E.,	East Orange, N. J.
Deats, Charles Taylor,	E.E.,	Flemington, N. J.
Dembo, Louis Julius, (A)	C.E.,	Baltimore, Md.
Dimmig, Daniel Benjamin, (A)	Ch.E.,	East Greenville.
Dolby, Harry Jackson, (A)	Chem.,	Seaford, Del.
Donovan, William Michael, (A)	C.E.,	Philadelphia.
Dorkin, Louis Harry, (A)	Bus.,	Bridgeport, Conn.
Dougherty, James Gwynne, (A)	El.Met.,	Beaver.
Downes, Kenneth McIntire, (A)	Ch.E.,	Harrisburg.
Droescher, LeRoy Adolph, (A)	M.E.,	Baltimore, Md.
DuBois, Arthur William, (C)	Bus.,	Coudersport.
Dvorschak, Ambrose Edward, (A)	B.A.,	Drifton.
Dyer, Harry Buttorff, (A)	C.E.,	Nashville, Tenn.
Eisenberg, Aaron Archibald, (A)	Ch.E.,	Baltimore, Md.
Eisenberg, Benjamin Newman, (A)	E.E.,	Baltimore, Md.

Eshbach, Irad Vernon, (A)	Ch.E.,	Pennsburg.
Esterson, Milton Max,	M.E.,	Baltimore, Md.
Ettelman, Benjamin, (A)	C.E.,	Philadelphia.
Farrington, James Royce, (A)	E.E.,	Annandale, N. J.
Finkelstein, Abraham,	Biol.,	Scranton.
Fisher, Jacob Runkle, (A)	E.E.,	New Germantown, N. J.
Fleischer, Abraham, (A)	C.E.,	Baltimore, Md.
Flom, Samuel Louis,	C.E.,	Northampton.
Frain, Jacob Frank, (C)	C.E.,	Williamsport.
Frank, Paul Melville, (A)	E.M.,	Allentown.
Frankenfield, Warren Ezra, (A)	M.E.,	Ambler.
Fuhrmann, Harry Philip, (A)	Ch.E.,	Shamokin.
Garrett, William Starling (A)	M.E.,	Roanoke, Va.
Gery, Ralph William, (A)	E.E.,	Sinking Spring.
Gildersleeve, Gordon Hamilton, (D)	E.E.,	East Orange, N. J.
Goldberg, Leopold E.,	Biol.,	Scranton.
Goldman, Hyman, (A)	Ch.E.,	Easton.
Goodwin, James Heathcott, (A)	Bus.,	East Liverpool, O.
Gott, Eugene Cissel, jr., (D)	El.Met.,	Washington, D. C.
Gulick, Henry Burr, (D)	Ch.E.,	Brooklyn, N. Y.
Hall, Frank Allen, (A)	Biol.,	Middletown, Conn.
Hall, William McLaurine, jr., (A)	Ch.E.,	Maysville, Ky.
Heiligman, Harold Abraham, (A)	Ch.E.,	Lehighton.
Henneberger, Thomas Clinton, (C)	E.E.,	Chambersburg.
Henrich, Vincent Christian, (A)	Ch.E.,	Lebanon.
Herrington, Arthur Smith, (D)	Bus.,	Latrobe.
Hicks, Robert Clayton, jr.,	E.E.,	Philadelphia.
Hinchman, Robert Mills, (A)	Ch.E.,	Westfield, N. J.
Hollenback, Elliott Hudson, (A)	El.Met.	Reading.
Hood, John William, (A)	El.Met.	Knoxville, Tenn.
Howard, John Myers, Jr., (C)	Bus.,	Latrobe.
Humphrey, James Young,	Geol.,	Wilkes-Barre.
Jacobs, Frank Aaron, (A)	Ch.E.,	Bethlehem.
Johnson, Vernon Edward, (D)	Bus.,	Southwick, Mass
Jones, Howard Dewey, (A)	C.E.,	Baltimore, Md.
Katzenstein, Leo, (A)	Math.,	Johnstown.
Kaufman, Samuel Russell, (A)	Ch.E.,	Exeter Boro.
Kay, Sidney Garner, (A) (E)	El.Met.,	Harrisburg.
Keeley, Martin J., (B)	N.E.,	Hoboken, N. J.

Kistler, George Anson,	C.E.,	Allentown.
Kleckner, Ellis Henry, (A)	M.E.,	Bethlehem.
Kline, John Milton, (D)	Met.,	Allentown.
Kline, Luther Henry, (A)	B.A.,	Northampton.
Knerr, George Russell, (A)	Ch.E.,	Allentown.
Knerr, Russell Master, (A)	B.A.,	Allentown.
Kopf, Otto Willard, (A)	E.E.,	New Britain, Conn.
Laffey, George Barnes, (A)	C.E.,	Paterson, N. J.
Larson, Harry Gustav, (A)	C.E.,	Limestone, N. Y.
Lawrie, William Newbold, (B)	E.E.,	Oxford.
Leech, William Albert, jr., (A) (C)	M.E.,	Mt. Pocono.
Lewers, William Wright, (A)	Ch.E.,	Wilkes-Barre.
Locke, Harold Glenwood, (A)	Ch.E.,	Camden, N. J.
Loeser, Edward Martin, (A)	Ch.E.,	Elizabeth, N. J.
Luckenbach, Richard Kraemer, (A)	N.E.,	Tyrone.
McGovern, Edward William jr., (A)	Ch.E.,	Hammonton, N. J.
Maddox, Henry Randolph, (A)	M.E.,	Princess Anne, Md.
Margolin, Philip, (A)	C.E.,	Baltimore, Md.
Maurer, Charles Pehle, (C)	E.M.,	Wilkes-Barre.
*Massart, Michael James, (A)	E.M.,	Bethlehem.
Mello, Eustaquio Gomes de,	E.E.,	Capella, Alagoas, Brazil.
Merkel, Norman Schoenly, (A)	Ch.E.,	East Greenville.
Miller, Albert Jacob, (A)	M.E.,	Easton.
Miszkiel, Victor Stanly, (A)	E.E.,	Ashley.
Morgan, Frank Brennesholtz, (D)	Bus.,	Westfield, N. J.
Morgan, James Willard, (A)	E.M.,	Altoona.
Morgan, Warren Thomas, (A)	M.E.,	Freeland.
Mulford, Hilliard Nelson, (A) (E)	Ch.E.,	Brooklyn, N. Y.
Mullady, Thomas Francis, (A)	E.M.,	Brooklyn, N. Y.
Myers, Walter Frey, jr., (B)	E.M.,	York.
Nass, George, 3rd, (B)	M.E.,	Philadelphia.
Nesterowicz, John James, (A)	Ch.E.,	Buffalo, N. Y.
Nolan, James Francis,	Bus.,	Phillipsburg, N. J.
Norkiewicz, John Anthony, (A) (C)	C.E.,	Shenandoah.

*Died October 22, 1918.

North, Ralph Mason, jr., (C)	N.E.,	Verona, N. J.
Obert, Franklin Comfort, (A)	Bus.,	Lehighton.
Oehm, Frederick Arthur, (C)	M.E.,	Baltimore, Md.
Parker, Willis Jones,	B.A.,	West Pittston.
Pfeiffer, David Clifford, (A)	M.E.,	Washington, D. C.
Power, Paul Carroll, (D)	Met.,	Crafton.
Powles, John Grant,	Met.,	Los Angeles, Cal.
Pumphrey, John Walter,	C.E.,	Brooklyn, Md.
Raff, Richard Davis, (B)	Ch.E.,	Canton, O.
Rathbone, Monroe Jackson, jr., (C)	Ch.E.,	Parkersburg, W. Va.
Rheinfrank, Frederick Wagner, (A)	Bus.,	Port Chester, N. Y.
Rice, Robert MacLean, (A)	E.E.,	Reading.
Ridgaway, Thomas Norris, (D)	C.E.,	Baltimore, Md.
Riebe, Herman William,	C.E.,	Lansford.
Rieman, Caspar William, (A)	Chem.,	Newark, N. J.
Rigby, John Marion, (A)	C.E.,	Spartansburg, S. C.
Rights, Theodore Balfour, (A)	C.E.,	Roselle, N. J.
Ritchie, Paul, (A)	M.E.,	Millville, N. J.
Roche, George Joseph, (A)	E.E.,	Baltimore, Md.
Rudy, Walter Dana, (D)	Ch.E.,	Mt. Airy.
Roy, Ernest Hood.	M.E.,	Newton, N. J.
Sakievich, Anthony Joseph, (A)	C.E.,	Baltimore, Md.
Sargent, Thomas Parsons, (D)	N.E.,	Mahwah, N. J.
Savaria, Gaspard Maurice, (A)	E.E.,	Woonsocket, R. I.
Sayre, William Heysham, jr., (A)	M.E.,	Glen Ridge, N. J.
Schaub, William Otto, (C)	E.M.,	Baltimore, Md.
Schneider, Carl Louis, (A)	M.E.,	Elizabeth, N. J.
Schofer, Carl Henry, (A)	E.M.,	Reading.
Schrader, Michael Cornelius, (A)	B.A.,	Bethlehem.
Scott, Alfred Beverly, (A)	M.E.,	Baltimore, Md.
Schultz, William Reed, (D)	El.Met.,	Morristown, N. J.
Shaner, George Faust, (A)	C.E.,	Pottstown.
Siebecker, Walter, (A)	Bus.,	Scranton.
Slabasesky, Henry Theodore, (A)	E.E.,	Ashley.
Sprecher, Samuel Roy,	E.E.,	Manheim.
Steel, Harry Leyland, (A)	Ch.E.,	Cape May Court House, N. J.

Steiner, Carl Herman, (A)	E.E.,	Reading.
Stelle, Harold Alexander, (A)	Ch.E.,	Scranton.
Streeter, Dwight Newton, (A)	M.E.,	Belleville, N. J.
Suender, Russell Light, (A)	E.M.,	Frackville.
Summers, Milo Whitney, (B)	C.E.,	Washington, D. C.
Sunderland, William Alexander, (A)	E.M.,	Danbury, Conn.
Thompson, George Stephen,	E.M.,	Shaft.
Tomlinson, Robert Scott,	E.E.,	Elizabeth, N. J.
Tumbler, Joseph, (A)	Ch.E.,	Baltimore, Md.
Uhlig, William Frank, (A)	E.M.,	East Orange, N. J.
Vehslage, Morrell Leslie, (A)	Ch.E.,	Irvington, N. J.
Vogeley, Theodore Kenneth, (A)	E.M.,	Butler.
Walker, Percy Franklin, (A)	C.E.,	Harrisburg.
Ward, Clemson Hays,	Chem.,	Oil City.
Wasser, Norman Henry, (A)	Ch.E.,	Bethlehem.
Weidenmyer, Uriah Howell, (A)	C.E.,	Harrisburg.
Weirbach, Charles Jacob,	E.E.,	Hellertown.
Weiss, John Richard Joseph, (C)	M.E.,	Bethlehem.
Weiss, Peter Francis, (B)	B.A.,	Bethlehem.
Wentling, Lee Grant, (A)	Ch.E.,	Conshohocken.
White, Harry James, (C)	B.A.,	Altoona.
Whitmore, William Kendal, (A)	E.M.,	Shamokin.
Wilson, Alvin Turner, (A) (C)	Ch.E.,	Bethlehem.
Wilson, Ralph Lawrence, (A)	El.Met.,	Canton, O.
Winterhalter, William Charles, Jr., (C)	Met.,	Crafton.
*Wohlsen, Richard,	E.E.,	Lancaster.
Wolfe, Charles Russell, (A)	Ch.E.,	Cranbury, N. J.
Woodring, Ralph Walton, (A)	Ch.E.,	Bethlehem.
Wright, Charles Henry,	C.E.,	St. Clair.
Wright, Henry Ovengton, (A)	M.E.,	Westfield, N. J.
Yeide, Harry Elwood, (B)	E.E.,	Weatherly.
Yen, Chun Tai,	E.M.,	Kiangsi, China.
Yu, Ching Sung,	C.E.,	Kulangsu, Amoy, China.

FRESHMAN CLASS

Class of 1922

	Course	Residence
Agnew, Franklin Chambers, (A) (E)	M.E.,	Plattsburg, N. Y.
Alexander, Gavin, jr., (C)	Ch.E.,	Bethlehem.
Allen, George Kestner,	Ch.E.,	Reading.

*Died October 8, 1918.

Allen, Roy Dawson, (A)	M.E.,	Belvidere, N. J.
Alrich, John Duffield, (A)	E.E.,	Bethlehem.
Altmiller, Charles Henry, (A)	E.M.,	Hazleton.
Ancona, Frederick Bechtel, (A)	E.E.,	Reading.
Bachman, Wilbur George Tripple, (A)	Bus.,	Allentown.
Badham, John Terry, (A)	E.M.,	Birmingham, Ala.
Barnes, George Eric, (A) (E)	C.E.,	Washington, D. C.
Barnett, Charles Mitchell, jr., (A) (E)	Bus.,	New York, N. Y.
Baron, Lester Joseph,	Ch.E.,	Atlantic City, N. J.
Barthold, Lee Girard, (A)	Bus.,	Bethlehem.
Bates, Frederick Woolworth, (A) (C)	B.S.,	Canton, O.
Beal, Russell Adam John,	C.E.,	Easton.
Beatty, Seth Keeney, (B)	Bus.,	Wilkes-Barre.
Beck, Rodney Maurer,	Ch.E.,	Philadelphia.
Beech, Rozier James, (A)	Ch.E.,	Washington, D. C.
Beeckel, Hermann Charles,	E.M.,	Philadelphia.
Bergdoll, Fred Ferdinand,	B.S.,	York.
Best, Ralph Walter,	E.E.,	Allentown.
Bevan, Lathrop, (C)	C.E.,	East Orange, N. J.
Bick, Carl Ernest, (A)	Ch.E.,	Wyomissing.
Bingham, Charles Joseph, (A)	B.A.,	Paterson, N. J.
Bockel, George Robert, (A)	C.E.,	Altoona.
Boltz, Joseph Light, (A)	C.E.,	Lebanon.
Bowler, William Lloyd,	M.E.,	Glenside.
Bowman, John Sigler, (A)	C.E.,	Harrisburg.
Bowman, Paul Emil, (A)	Ch.E.,	Gilberton.
Boyd, James Andrew, (A)	B.S.,	Montvale.
Boyer, Willet Albright,	M.E.,	Bethlehem.
Boyle, Norman Thomas, (A)	E.E.,	Bethlehem.
Brewer, Warren, (B)	B.S.,	Newton Center, Mass.
Brubaker, Gordon Mark,	M.E.,	Millersburg.
Brugmann, William Hugh, (C)	Met.,	Syracuse, N. Y.
Brumbaugh, Granville Martin,	E.E.,	Washington, D. C.
Brunstein, Maurice, (A)	Ch.E.,	Atlantic City, N. J.
Burchill, William Reginald, (A)	Ch.E.,	Bayonne, N. J.
Burritt, Robert William, (A)	C.E.,	Philadelphia.
Bush, Donald Moyer, (A)	Ch.E.,	Glenside.
Cahill, Robert Francis, (A)	M.E.,	Washington, D. C.

Cahn, Calvert Jacob, (A)	Ch.E.,	Baltimore, Md.
Cahn, Edgar Bernard, (A)	Bus.,	Baltimore, Md.
Campbell, Paul, (A)	B.S.,	Mechanicsburg.
Caperton, Samuel Austin, (A)	E.M.,	Slab Fork, W. Va.
Carey, James White, jr., (A)	M.E.,	Wenonah, N. J.
Carrig, Robert Francis, (A)	Chem.,	New Haven, Conn.
Carroll, Henry,	M.E.,	Bethlehem.
Carroll, Randolph Fitzhugh, (D)	C.E.,	Washington, D. C.
Chao, Pai Hua,	Met.,	Hanyang, China.
Chase, Theodore Elrod,	M.E.,	Allentown.
Chen, Chung Fa,	E.M.,	Changsha, China.
Chesterman, Frank Edwin, jr., (A)	M.E.,	Philadelphia.
Clark, Richard James, (A)	Ch.E.,	Bethlehem.
Cohen, Aaron Jacob, (A)	C.E.,	Trenton, N. J.
Cohen, Samuel Meyer, (C)	C.E.,	Bridgeport, Conn.
Coleman, Joseph, (A)	Bus.,	Bethlehem.
Coleman, Joseph Aitken, jr., (A)	M.E.,	Norristown.
Coleman, Lee Heicher, (B)	M.E.,	Steelton.
Collins, Earle Weidner,	Bus.,	Bethlehem.
Confer, Thomas Fister, (A)	A.B.,	Hamburg.
Connell, Charles Augustus, (A)	M.E.,	Plattsburg, N. Y.
Connors, George Wattie, 2nd, (A)	B.S.,	Spartanburg, S. C.
Coons, Robert Ball,	Bus.,	Ballston Spa, N. Y.
Cornelius, George Emil Wagner,	Ch.E.,	McKeesport.
Cory, Robert Cortelyou, (C)	Ch.E.,	Newark, N. J.
Coxe, Edward Haviland, jr.,	E.E.,	Pittsburgh.
Craig, Arthur Conery, (A)	Ch.E.,	Merchantville, N. J.
Craig, Colgate, (A)	B.S.,	Montclair, N. J.
Crandall, Edwin Paul, (B)	C.E.,	Williamsport.
Crawford, James Coalter, jr., (B)	E.M.,	Mt. Vernon, N. Y.
Curtin, Thomas Joseph, (B)	Ch.E.,	Shenandoah.
Curts, Charles Wilson, (A)	Met.,	Paterson, N. J.
Damiani, Pasquale George, (A)	B.A.,	Bethlehem.
Daniels, Elliott Foster,	E.E.,	Jersey City, N. J.
Dashiell, Benjamin Jones, (A)	E.M.,	Iona, N. J.
Davis, Norris Dunglison, (B)	N.E.,	Conshohocken.
DeDan, Jules Felix, (A)	C.E.,	Atlantic City, N. J.
Deibert, Milo LeRoy, (B)	B.S.,	Lehighton.
Deitz, Joseph, (A)	B.S.,	Steubenville, O.

Denburger, Fred Herman, (A)	C.E.,	Bethlehem.
DeTurk, Elmer Francis, (A)	E.E.,	Reading.
DeTurk, Eli Raymond Strunk, (A)	B.S.,	Griesemersville.
Dix, Harold Seaman, (A)	Ch.E.,	Westfield, N. J.
Doan, William Douglas, (A)	E.M.,	Lansdale.
Dolan, Joseph Bernard, (A)	E.M.,	Pottsville.
Dowd, Raymond Bernard, (A)	Bus.,	Springfield, Mass.
Downing, Edmond Joseph,	C.E.,	Wilkes-Barre.
Dreyer, Elmer Lewis,	E.E.,	Brookland, D. C.
Dunkle, Charles Josiah,	Bus.,	Harrisburg.
Dunkle, Josiah Andrew, (A)	Ch.E.,	Steelton.
Eastman, Robert William, (A)	B.S.,	Mt. Vernon, O.
Eberhart, Isaac Kulp,	B.S.,	Bethlehem.
Edwards, Delbert Roderick,	E.E.,	Drifton.
Enslin, Everett Morgan, (A)	N.E.,	Bethlehem.
Eppinger, LeRoy Amos, (A)	E.M.,	Steelton.
Esty, Lucien Coy, (A)	N.E.,	Bethlehem.
Ewing, George Newlin, (C)	Met.,	Philadelphia.
Fairhurst, Henry D., (A)	Bus.,	Paterson, N. J.
Faxon, Clifford Henry, (A)	C.E.,	Huntington, N. Y.
Fincke, Edward Jerome, (A)	C.E.,	Glenside.
Fink, Walter John, (A)	M.E.,	York.
Fleming, Richard, jr.,	B.S.,	Westfield, N. J.
Foote, Marshall Hanford,	Bus.,	South Norwalk, Conn.
Forney, Herman Charles, (A)	C.E.,	Philadelphia.
Forst, Arthur Daniel, jr.,	M.E.,	Trenton, N. J.
Frankel, Harry, (A)	E.M.,	Wilmington, Del.
Frazier, Donald Plumb, (A)	E.E.,	Aurora, Ill.
Freeman, Carlos Alphonso,	E.M.,	Caracas, Venezuela.
Freeman, George Camp, (A)	C.E.,	Millington, N. J.
Fresoli, Michael,	B.A.,	Bethlehem.
Friedman, Jacob, (A)	Bus.,	Bethlehem.
Fry, Wallace C., (A)	M.E.,	Asbury Park, N. J.
Furgason, Leonard Crary,	Ch.E.,	Lockport, N. Y.
Gaiser, George Lincoln, (C)	C.E.,	Newark, N. J.
Gallagher, Michael, (A)	M.E.,	Allentown.
Gandal, Isadore, (A)	C.E.,	Bethlehem.
Gangewere, Ernest Paul.	M.E.,	Chattanooga, Tenn.
*Gehman, John Ralph, (A)	M.E.,	Bethlehem.

*Died October 15, 1918.

Gelly, George Balfour, (A) (C)	N.E.,	Yonkers, N. Y.
Gelston, Charles Bertram, (A)	E.E.,	Washington, D. C.
Gephart, Tom M., jr., (A)	E.E.,	Bedford.
Gerber, William Eugene,	Ch.E.,	York.
Gerhard, Lester George, (B)	B.A.,	Lehighton.
Gerlach, Jacob Aaron,	M.E.,	Easton.
Gillespie, Elwood David,	Ch.E.,	Catasauqua.
Gillett, Harry, jr.,	M.E.,	East Cleveland, O.
Gingrich, Winfield Adam,	C.E.,	Williamsport.
Glasmire, Frederick Wanner, (A)	B.S.,	Womelsdorf.
Glassgold, George,	E.M.,	Woodridge, N. Y.
Gleason, Raymond Vincent, (A)	B.S.,	Woonsocket, R. I.
Glen, Maxwell, (A)	Bus.,	Newbury, Mass.
Gooding, Charles Pennypacker,	B.A.,	Wilmington, Del.
Grace, George Joseph, (B)	B.S.,	Brooklyn, N. Y.
Green, David, (A)	N.E.,	Atlantic City, N. J.
Greene, Nelson George (A) (E)	Ch.E.,	Cleveland, O.
Greene, Omar Vivien, (A)	Met.,	Yonkers, N. Y.
Gross, Abraham Albert, (A)	Ch.E.,	Harrisburg.
Gulick, Wilson McKee, (A)	E.M.,	Philadelphia.
Gurley, Roger Knight, (A)	E.M.,	Harrisburg.
Hackman, Henry David, jr., (A)	B.S.,	Womelsdorf.
Hackman, Norman LeRoy, (A)	B.S.,	Philadelphia.
Haldeman, Samuel Tyson, (B)	B.S.,	Williamsport.
Hall, George Arthur, (A)	Bus.,	East Orange, N. J.
Hall, Philip Wells, jr., (B)	Bus.,	Cranford, N. J.
Handwerk, Erwin Casper, (A)	B.S.,	Slate Dale.
Hardcastle, Edward, (A)	E.E.,	Easton, Md.
Harris, Nathaniel Kirby, (C)	C.E.,	Athens.
Hartman, Edward Paul,	M.E.,	Bethlehem.
Hartshorne, Alfred Cope,	N.E.,	Phoenixville.
Harvey, Gardner Roger, (C)	Ch.E.,	Newark, N. J.
Haslam, George Stevenson, (A)	E.M.,	Palmerton.
Hastings, Robert William, (B)	Bus.,	Joliet, Ill.
Hatch, Allen,	E.M.,	Philadelphia.
Heim, James Henry, (C)	Biol.,	Kane.
Henry, Merit Richard, (A)	N.E.,	Bethlehem.
Henzelman, Carl Franklin, (A) (E)	B.S.,	Easton.
Hering, Henry Richardson, (A)	M.E.,	New York, N. Y.

Herman, Arthur Louis,	Met.,	Bethlehem.
Hermanson, Arthur Julius,	Ch.E.,	Bridgeport, Conn.
Hewitt, Alfred George, (A)	Ch.E.,	Washington, D. C.
Higgins, William Matthew,	C.E.,	Newark, N. J.
Hill, George Snow, jr., (A)	B.S.,	Towanda.
Hitchner, Adam Hannan, (A)	C.E.,	Woodbury, N. J.
Hoch, Albert Jackson, (A)	Met.,	Reading.
Hocker, John Stanley, (A)	El.Met.,	Middletown.
Hoelzle, Leon Henri, (A)	B.S.,	Sharon.
Hoffa, Cyrus, (A)	E.E.,	Wilkes-Barre.
Hoffmaster, George Christian, (A)	C.E.,	Pottsville.
Hofford, Herbert,	Ch.E.,	Allentown.
Hogue, Francis Herbert Kerr, (A)	M.E.,	Philadelphia.
Hopkins, George Whitefield, (A)	M.E.,	Cleveland, O.
Horine, John Winebrenner, jr., (A)	E.E.,	Columbia, S. C.
Howerth, Dwight Goldwin, (A)	E.E.,	Shamokin.
Huang, Show Chuan,	E.M.,	Kaiping, Chihli, China.
Huber, Francis Christian, (A)	Ch.E.,	New York, N. Y.
Huber, Raymond Fahnestock, (A)	N.E.,	Chambersburg.
Huffman, Raymond Lloyd, (A)	E.M.,	Bethlehem.
Hughart, William Oden, (C)	Met.,	Moylan.
Hughes, Harry Herman, (A)	C.E.,	Pottsville.
Hughes, Rupert DeArmond, (B)	Ch.E.,	Montclair, N. J.
Hull, John Sommers, (A)	M..E.,	Cleveland, O.
Huneke, Harry Karl, (B)	N.E.,	Brooklyn, N. Y.
Hurtado, Juan,	C.E.,	Mexico City, Mexico.
Hutchinson, Robert George, 3rd, (A)	M.E.,	Montclair, N. J.
Ide, Clinton, (A)	E.E.,	Harvey's Lake.
Isaacson, Nathan, (A)	B.S.,	Spring Valley, N. Y.
Israel, Fielder,	Ch.E.,	Laurel, Md.
Jacobs, Mahlon Kemmerer,	E.M.,	Philadelphia.
Jagels, Charles John Henry,	Ch.E.,	New York, N. Y.
Jebb, William Thomas, (A)	Ch.E.,	Lawndale.
Jefferson, Moncrief Ostrander,	N.E.,	Riverhead, N. Y.
Job, James Robert, (A)	C.E.,	Nanticoke.
Johnston, Jerry Smith, (A)	C.E.,	Camden, N. J.

Jones, Richard Thomas, jr., (D)	Bus.,	Philadelphia.
*Kachline, Warren Frederick, (A)	Bus.,	Reading.
Kadow, Franklin Campbell, (B)	B.S.,	Cleveland, O.
Kasten, John Bernard, (A)	E.M.,	Nyack, N. Y.
Keenan, Raymond Anthony, (A)	M.E.,	New Kensington.
Kehler, Lloyd Benjamin,	M.E.,	Shamokin.
Kehoe, Henry Joseph, (A)	M.E.,	Wilkes-Barre.
Kennedy, Cyril Owen,	Bus.,	New Haven, Conn.
Kennedy, Dewey Lester, (A)	Bus.,	Duncannon.
Kennedy, Richard Deane, (A)	B.A.,	Altoona.
Kenney, James Joseph, (A)	Ch.E.,	Parsons.
Kilbourn, William Robert,	M.E.,	Williamsport.
Killmer, Jack Kaufman,	Ch.E.,	Reading.
Kivert, Joseph Albert,	Ch.E.,	Northampton.
Kleine, Herbert Julius, (A)	M.E.,	Altoona.
Knepper, Henry jr., (B)	E.E.,	Somerset.
Knies, Earl Vernon, (A)	M.E.,	Bethlehem.
Knoderer, Claude Luther, (A)	E.E.,	Steelton.
Knowles, Rowland Whitfield, (A)	B.S.,	Pottsville.
Korbel, Alexander,	M.E.,	Bethlehem.
Kozlakiewicz, Walter, (A)	C.E.,	Wilkes-Barre.
Krecker, William Henry, Jr., (C)	C.E.,	Philadelphia.
Kressley, Clement Daniel Jacob, (A)	B.S.,	Allentown.
Labe, Jacob, jr., (A)	Bus.,	Philadelphia.
Laffey, Alfred Walsh Barnes, (A)	B.S.,	Paterson, N. J.
Laing, Harold Eden, (A)	B.S.,	Asbury Park, N. J.
Lamb, Earl Washington,	E.M.,	Frackville.
Lambert, Tilghman Albert,	B.A.,	Allentown.
Landenberger, John Louis, (A)	N.E.,	Philadelphia.
Landis, Russell Henry, (A)	Met.,	Barto.
Larkin, Sylvester Makens, (B)	C.E.,	Norristown.
Latshaw, Ray Eisenberg, (A)	M.E.,	Royersford.
Lazarus, Franklin Thomas Wright,	M.E.,	Bethlehem.
Lee, Ralph William, jr., (A)	C.E.,	Washington, D. C.

*Died October 25, 1918.

*Leonard, Bernard Elder, (A)	Ch.E.,	Chicopee Falls, Mass.
Lerch, Robert Lee, (D)	Ch.E.,	Takoma Park, D. C.
Lewando, Royal Dewey, (A)	B.S.,	Atlantic City, N. J.
Lewis, Arlington Reuben, (A)	Ch.E.,	Palmerton.
Lewis, Daniel Hoover, (A)	B.S.,	Pottsville.
Liddle, William Pfeiffer, (A)	Bus.,	Perth Amboy, N. J.
Linderman, Beverly Warner,	E.M.,	Beverly, N. J.
Linderman, Robert Packer,	Bus.,	Bethlehem.
Linderman, Stuart Henry, (A)	C.E.,	Beverly, N. J.
Little, Arthur Rhea, (A)	E.E.,	Petersburg.
Liveright, Henry,	Ch.E.,	Clearfield.
Long, William Merrill, (D)	Bus.,	Elkins Park.
Loomis, Donald Dewey, (A)	B.S.,	New York, N. Y.
Lorch, George Herman, (D)	E.E.,	Washington, D. C.
Loy, Chester Barr, (A)	M.E.,	Steelton.
Lundell, Ralph Harold,	B.S.,	Montclair, N. J.
Lutz, Warren Hornberger, (A)	E.E.,	Denver.
Lyons, William, (A)	N.E.,	Holyoke, Mass.
MacGregor, Donald, (A)	N.E.,	Franklinville, N. J.
McCabe, James Murphy, (A) (E)	N.E.,	Titusville.
McConnell, George,	Bus.,	Butler.
McFadden, John Joseph, (A)	E.E.,	Allentown.
McGinley, Edward Francis, (A) (E)	B.S.,	Chester.
McNally, William Francis Sheridan, (D)	Bus.,	Easton.
McPherson, John Douglas, 3rd, (A)	E.E.,	Orangevale, Cal.
Major, Harold Wagner, (A)	Ch.E.,	Lehman.
Manahan, Everett Cutler, (A) (C)	C.E.,	Mt. Vernon, N. Y.
Maraspin, Davis Goodwin, (D)	Bus.	Malden, Mass.
Marquez, Benjamin,	M.E.,	Chihuahua City, Chihuahua, Mexico.
Marshall, George Ayre,	M.E.,	Wilkes-Barre.
Marshall, James Floyd, (A)	M.E.,	Wilkes-Barre.
Martin, Fred Lewis, (A)	B.S.,	Coudersport.
Martin, Griffith Williams, (D)	Chem.,	Kingston.
Martz, George Otto, (A)	E.M.,	Shamokin.

*Died October 9, 1918.

Mason, Howard Bloom, (A)	Ch.E.,	Hazleton.
Mattson, William Raymond, (A)	C.E.,	Rockledge.
Mawbey, Stephen Corlies,	Ch.E.,	Jersey City, N. J.
Mercur, Robert Sayre, (C)	E.M.,	Harrisburg.
Michell, Albert McIlvaine, (A)	E.M.,	Marion, Ky.
Miller, Paul Edward, (B)	N.E.,	Bellwood.
Miller, Roy Francis, (A)	B.S.,	Altoona.
Miller, William Harold, (A)	N.E.,	Bridgeport, Conn.
Minnich, Perry James,	B.S.,	Cherryville.
Molloy, James Xavier, (B)	N.E.,	Bridgeport, Conn.
Monroe, Clyde Clinton,	Bus.,	Auburn, N. Y.
Monroe, Stewart, (B)	Bus.,	Cleveland, O.
Monroe, William Clegg, (A)	Bus.,	Greensboro, N. C.
Montalvo, Fernando,	Ch.E.,	Merida, Yucatan, Mexico.
Moorehouse, John Walter,	E.E.,	Monaca.
Morgan, Harold William,	C.E.,	Altoona.
Mowery, Walter Charles, (A)	B.S.,	Frackville.
Muhlenberg, Charles Henry, jr., (A) (E)	E.E.,	Reading.
Mumford, Warren Hindikofer, (C)	Bus.,	Lexington, Mass.
Murray, Joseph Leo,	Chem.,	Philadelphia.
Nadig, Stanton Elwell,	N.E.,	Allentown.
Naile, Ralph Henry, (A)	B.S.,	Norristown.
Neumeyer, John Henry, jr., (A)	Bus.,	Easton.
Newbaker, Philip Charles, (A)	M.E.,	Philadelphia.
Newhart, Russell James,	M.E.,	Stockertown.
Newlin, James Mennert, (A)	Ch.E.	Sparrows Point, Md.
Newman, Preston Fuller, (A)	M.E.,	Belmar, N. J.
Nichols, Robert Warren, (A)	E.E.,	Asbury Park, N. J.
Niekamp, William Stacy, (A)	Met.,	St. Louis, Mo.
Oberholtzer, Wayne Shankweiler, (A)	B.S.,	Barto.
O'Keefe, Francis Callistus,	N.E.,	Rockville, Conn.
O'Keefe, Gerald Carroll, (A)	Bus.,	New Haven, Conn.
Orr, Allen Alexander, jr., (A)	Ch.E.,	Lewistown.
Ott, Harold Joseph, (A)	M.E.,	Allentown.
Pancoast, Leon Gifford, (A)	M.E.,	Delanco, N. J.
Pankowski, Joseph Valent, (A)	Ch.E.,	Eckley.
Parker, Raymond White, (B)	E.E.,	Washington, D. C.

Pasolli, Emil Gabriel, (A)	E.M.,	Paterson, N. J.
Passmore, Henry Etter, (B)	M.E.,	Cleveland, O.
Person, Wilbur William, (A)	B.S.,	East Mauch Chunk.
Pfeiffer, John Jacob, (A)	B.S.,	Washington, D. C.
Phipps, Claude Arnold, (A)	C.E.,	Willow Grove.
Platt, Harold Wentzell,	C.E.,	Bridgeton, N. J.
Platt, Harvey Elmore, jr., (A)	N.E.,	Philadelphia.
Potts, Ralph Harrison, (A)	Ch.E.,	Reading.
Prigohzy, Adolph, (C)	E.M.,	Brooklyn, N. Y.
Quier, Kenneth Elwell,	M.E.,	Bethlehem.
Rakestraw, Theodore Horace, (A)	E.M.,	Elizabeth, N. J.
Randall, Harradon,	C.E.,	Lykens.
Redline, Paul Wilson,	M.E.,	Bethlehem.
Reichard, Paul Clader,	M.E.,	Allentown.
Reiff, Robert Vincent, (A)	E.E.,	New Cumberland.
Rex, Harold Berlin, (A)	E.E.,	Lehighton.
Reynolds, Edwin Louis,	C.E.,	Chevy Chase, D. C.
Reynolds, John Elliott, (A)	M.E.,	Bridgeport, Conn.
Richardson, Charles Parker,	C.E.,	Pottstown.
Riley, John Alan, (A)	E.M.,	Bridgeport, Conn.
Roberts, Philip Ogden, (A) (C)	B.S.,	Jersey City, N. J.
Robison, Edward George (C)	Ch.E.,	Warren, Ohio.
Rogers, Reginald Brock, (A)	M.E.,	Huntington, N. Y.
Rollman, Earl Wilson, (A)	C.E.,	Reading.
Rosenbaum, Paul,	Ch.E.,	Philadelphia.
Rosenberg, Charles Irving, (A)	B.S.,	Bridgeport, Conn.
Salmon, Clarence Prior,	Ch.E.,	LaSalle, N. Y.
Saltzman, Auguste Louis,	M.E.,	East Orange, N. J.
Satterthwait, Charles Shoemaker,	C.E.,	Burmont.
Schaefer, Bernard Edward, (A)	E.M.,	East Mauch Chunk.
Schier, Wallace,	Bus.,	Richmond Hill, N. Y.
Schiller, Louis Sidney,	M.E.,	Scranton.
Schimpf, Henry Leonard, jr., (A)	B.S.,	Philadelphia.
Schlesman, Carleton Hecker,	Ch.E.,	Allentown.
Scholz, Edmund Richard, (A)	Ch.E.,	Adams, Mass.
Schonhardt, John Clarence, (A)	El.Met.,	Johnstown.
Schuler, Norman Edward Isaac, (A)	El.Met.,	Bethlehem.
Schuler, Robert Eustace (A)	B.S.,	Gadsden, Ala.
Schwartz, Earl Dum, (A)	C.E.,	Harrisburg.

Scofield, Edmund Preston, (A)	Ch.E.,	Bayonne, N. J.
Scott, Winfield William, (A)	B.S.,	Minersville.
Sears, Phillips Shirley, (C)	E.E.,	Huntingdon.
Selden, William Scott Keech,	E.E.,	Washington, D. C.
Sharp, Charles Compton,	C.E.,	Bridgeton, N. J.
Shearer, Walter Louis, (A)	Ch.E.,	Washington, D. C.
Sheiry, Edward Slater, (A) (E)	E.E.,	Washington, D. C.
Sidebotham, John Brear, jr., (A)	N.E.,	Frankford.
Silsby, Charles Forbes, (A)	Ch.E.,	Washington, D. C.
Siracusa, Frank Joseph, (A)	C.E.,	Atlantic City, N. J.
Smith, Hubert Bell, (A)	C.E.,	Philadelphia.
Smith, Lester, (B)	E.E.,	Clinton, N. J.
Smith, Valentine Roy, (A)	E.M.,	East Mauch Chunk.
Snavely, Shirley Ehnes, (A)	Ch.E.,	Roanoke, Va.
Snyder, Amandus Deischer, jr., (B)	Ch.E.,	Pennsburg.
Snyder, Gehrad, 3rd, (B)	B.S.,	Bloomsburg.
Spatz, Warren Cyrus, (A)	E.E.,	Reading.
Stanton, Thomas William, (A)	Met.,	Newark, N. J.
Stein, Isador Albert,	M.E.,	Dunmore.
Stephenson, Robert Harper jr., (A)	M.E.,	Homeville, Va.
Stewart, Hugh Daniel, (C)	El.Met.,	Clearfield.
Stewart, Joseph Baird,	N.E.,	Philadelphia.
Stewart, Robert Gladstone, (A)	B.S.,	Harrisburg.
Stout, Clyde Myers, (D)	E.E.,	Berwick.
Strauch, Charles Carter, (A)	M.E.,	Pottsville.
Stutz, George Frederick Adelbert, jr., (A)	Ch.E.,	Washington, D. C.
Svihra, Albert, (A) (E)	N.E.,	Bridgeport, Conn.
Swinton, George Robert,	C.E.,	Atlantic City, N. J.
Switz, Theodore MacLean,	Ch.E.,	East Orange, N. J.
Sylvan, Rolf E., (D)	N.E.,	New York, N. Y.
Tavenner, William Henry, (A)	E.M.,	Washington, D. C.
Tench, Harold Womer, (A)	M.E.,	Wilkes-Barre.
Thomas, Richard Sampson,	M.E.,	Wilkes-Barre.
Tice, Edward Grant, jr., (A)	M.E.,	Bethlehem.
Tollin, Nathan, (B)	M.E.,	Wilmington, Del.
Trauger, Wilmer Kohl, (A)	B.S.,	Revere.
Turner, Frank Martin, (A)	Bus.,	Bethlehem.
Tyler, William Boyd, (B)	C.E.,	Cape May Court House, N. J.

VanNort, Lawrence Northrup, (A)	M.E.,	Scranton.
Vilotti, James Victor, (C)	Bus.,	Philadelphia.
Vogt, Harold James, (A)	Ch.E.,	Brooklyn, N. Y.
*Wacha, John Walter, (A)	B.S.,	Reading.
Walker, Stanley Beziat, (A) (E)	B.S.,	Baltimore, Md.
Wallace, Harold Dolson, (A)	C.E.,	East Orange, N. J.
Walmsley, Haines Preston (A)	El.Met.,	Birmingham, Ala.
Warren, Austin Bartlett,	N.E.,	Westfield, Mass.
Warshow, Irving Henry, (A)	N.E.,	New York, N. Y.
Watson, James Angus, jr., (D)	E.E.,	Silver Spring, Md.
Weaver, William Abbott, (A) (C)	Ch.E.,	Wilkes-Barre.
Weber, Herman Ludwig, (A)	B.A.,	Allentown.
Weiler, Charles Barton,	C.E.,	Glenolden.
Weiss, Theodore Solomon,	Chem.,	Quakertown.
Wescoat, George Nelson, (A)	Ch.E.,	Collingswood, N. J.
West, Samuel Brainard, (A)	Met.,	Pittsburgh.
Whims, Edmund Joseph,	C.E.,	St. Clair.
Whytock, Paul Knauss, (A)	Bus.,	Bethlehem.
Wilhelmi, George Oswald, (A)	M.E.,	Maywood, N. J.
Wilkinson, George,	C.E.,	Mt. Carmel.
Williamson, Stuart Worley,	E.E.,	Womelsdorf.
Wilson, Francis Vaux,	Bus.,	Philadelphia.
Wilson, Frederic William, jr.,	E.E.,	Pocomoke City, Md.
Wilson, John Edgar Miller, (A)	E.M.,	Bethlehem.
Witchey, Fred Benjamin, (A)	C.E.,	Mountain Grove.
Woelfel, Harold Martin, (A)	N.E.,	Freeland.
Wood, Robert Thomas, (B)	El.Met.,	Palmerton.
Wright, Wilford Franklin, (A)	Bus.,	Washington.
Wysocki, de, Frederick William, (A)	M.E.,	Asbury Park, N. J.
Yoder, David Nein, (A)	B.S.,	Manatawny.
Young, Cortland Ennis, (A)	C.E.,	Cape Charles, Va.
Young, Henry Elmer, (B)	Ch.E.,	Atlantic City, N. J.
Zantzinger, Richard Chew, (A)	E.E.,	Hyattsville, Md.
Ziegler, August Howard, jr., (A)	Bus.,	Huntington, N. Y.

*Died October 12, 1918.

SPECIAL STUDENTS

Barr, Morris,	Ch.E.,	Lubar, Volen, Russia.
Hill William M., jr.,	Chem.,	Sellersville.
Lau, Zan-Ding,	E.M.,	Shanghai, China.
Lee, Iee Tung,	E.M.,	Hungchow, Hupeh, China.
Long, Roy Seville,	E.M.,	Hopewell.
Ma, Chien Chung,	B.S.,	Samarang, Java.
Nesselbush, Louis Michael, (C)	Met.,	Buffalo, N. Y.
Oikawa, Hotori,	E.E.,	Japan.
Owens, Owen E., jr., (A)	Bus.,	Slatington.
Zinszer, Harvey Alfred,	B.S.,	Allentown.
Zweibel, Stanley Albert,	Bus.,	Bethlehem.

SUMMER SCHOOL STUDENTS

(Students whose names do not appear in the preceding lists and who attended Summer School only.)

	Course	Residence
Bachert, Homer Allison,	E.E.,	Bethlehem.
Dobbie, John jr.,	Ch.E.,	Niagara Falls, N. Y.
Fehnel, James William,	Ch.E.,	Bethlehem.
Keith, Isham V.,	E.E.,	Warrenton, Va.
Langan, Eugene F.,	Chem.,	Scranton.
Melville, C. Clennon,	C.E.,	Harrisburg.
Reid, Ricklef Allen,	E.E.,	Glen Ridge, N. J.
Sexton, Wray Edwards,	Math.,	Newark, N. J.
Takikawa, Yasus,	El.Met.,	Tokofu, Japan.

STUDENTS IN EXTENSION COURSES

The following are names of persons who are not matriculated students of the University but who are taking courses for which a certificate of collegiate credit is issued. This list does not include those who have merely registered for lecture courses or who attend the Lehigh Evening School. The extension courses are described on page 122.

The numbers that follow the names indicate the courses pursued, thus: 1, School Administration; 2, Junior High School; 3, Educational Sociology; 4, Educational Measurements; 5, Elementary Education; 6, Sociology; 7, Sociology, advanced course; 8, Elementary French; 9, Geology; 10, Educational Psychology;

11, Philosophy; 12, Latin Literature; 13, Rhetoric and Composition; 14, General Physics; 15, Grammar Grade Methods; 16, Demonstration School; 17, Oral English.

The following were enrolled in the Summer Session, 1918:

	Course	Residence
Allen, Edna M.,	14	Allentown.
Bardill, Marion F.,	5, 16	Bethlehem.
Bass, Florence E.,	5, 16	Bethlehem.
Benner, Emma Susan,	15, 16	Bethlehem.
Bishop, L. Antoinette,	1, 15, 16	Bethlehem.
Chubbuck, Mary,	14	Allentown.
Collins, Veronica,	5, 16	Bethlehem.
Collmar, Mrs. Norma McFall,	13	Easton.
Denburger, Edith,	5, 16	Bethlehem.
Graham, Helena,	5, 16	Bethlehem.
Heberling, Ella,	15, 16	Bethlehem.
Heckrotte, Sarah,	14	Allentown.
Heffner, Esther L.,	14	Allentown.
Hendricks, Nellie,	1, 16	Rockville, Conn.
Hess, Frances M.,	5, 16	Bethlehem.
Kessler, Hattie L.,	13, 15, 17	Nazareth.
Knecht, Mabel K.,	13, 17	Allentown.
Krauss, Blanche,	5, 16	Bethlehem.
McNamara, John Joseph,	15, 16	Bethlehem.
Mack, Edith L.,	5, 16	Bethlehem.
Murray, Marian H.,	5, 16	Bethlehem.
Nickum, Edith,	15, 16	Bethlehem.
Nolf, Laura A.,	5, 16	Bethlehem.
Pohl, Elizabeth Shimer,	1, 13, 16	Easton.
Ripple, Martha M.,	13, 5, 16	Hazleton.
Strohmeier, Adella,	13, 15, 17	Easton.
VanDyke, Ella Rebecca,	15, 16	Bethlehem.
Weaver, Martha,	14	Ferndale.
Winters, Sarah,	13	Allentown.

The following had enrolled for the Fall and Winter Sessions by February 1, 1919:

Armpriester, Helen,	6	Harrisburg.
Atherton, Flora, A.B., (*Wilson College.*)	7	Harrisburg.

Aumiller, Katherine, A.B., (*Wilson College.*)	7	Harrisburg.
Bachman, Charles C., A.B., (*Muhlenberg College.*)	1, 2, 12	Allentown.
Bahnsen, G. Elizabeth,	8	Coopersburg.
Baker, Alice,	6	Harrisburg.
Baldy, Lucy,	3	Allentown.
Barker, A. Mabel,	6	Harrisburg.
Beck, Florence, A.B. (*Wellesley College.*)	7	Harrisburg.
Beitzell, Andrew J., A.M., (*Franklin and Marshall College.*)	7	Harrisburg.
Benner, Emma Susan,	4	Bethlehem.
Bevan, Myrtle,	3	Hazleton.
Billow, M. O., A.B., (*Lebanon College.*)	7	Harrisburg.
Blake, A. Mabel,	6	Harrisburg.
Bowers, Jessie, A.M., (*Dickinson College.*)	7	Harrisburg.
Boyer, Mrs. Helen Bieber,	2	Rittersville.
Brodhead, Anna L.,	8	Mauch Chunk.
Brodhead, Emily,	8	Mauch Chunk.
Brunner, William Albert, A.B., (*Lebanon Valley College.*)	7	Harrisburg.
Buehler, Anna Fredericka,	7	Allentown.
Bullock, Ruth,	8	Mauch Chunk.
Burkholder, Mary,	7	Harrisburg.
Burns, Margaret,	3	Hazleton.
Buss, Leila,	8	Nazareth.
Cassler, Mae,	8	Nazareth.
Chubbuck, Mary,	9	Allentown.
Cobaugh, Florence H., A.B., (*Smith College.*)	7	Allentown.
Coffman, Mary,	3	Hazleton.
Collins, Veronica, A.B., (*Moravian College for Women.*)	8	Bethlehem.
Crawford, Julia,	8	Nazareth.
Crow, Martha,	11	Bethlehem.
Deemer, Lilian Susan,	4	Bethlehem.
Denburger, Edith, A.B., (*Moravian College for Women.*)	8	Bethlehem.

DeWire, Harry B.S., (*Bucknell University.*)	7	Harrisburg.
Doherty, Bridget A.,	3	Allentown.
Drown, Ruth Ruby,	5, 9	Bethlehem.
Dugan, Cora,	6	Harrisburg.
Dum, Elizabeth,	6	Harrisburg.
Edelman, Eva Jane,	4	Easton.
Eshenower, Grace,	6	Harrisburg.
Fahl, Stella,	5	Bethlehem.
Ferguson, Mrs. Bertha,	6	Harrisburg.
Ferguson, J. Frazier,	6	Harrisburg.
Fey, Mary W.,	3	Hazleton.
Fisher, Clara,	6	Harrisburg.
Frantz, Mrs. A. E.,	8	Nazareth.
Fritchey, Geneva,	6	Harrisburg.
Geist, Alma,	8	Mauch Chunk.
Geist, Howard,	1	Bethlehem.
George, Kathryn,	8	Bethlehem.
Gerhard, Helen S., Ph.B, (*Dickinson College.*)	7	Allentown.
Goetz, G. Herman,	6	Harrisburg.
Gougler, Susan,	6	Harrisburg.
Grainger, Josephine,	3	Allentown.
Greider, Emma Cora, A.B., (*Hunter College.*)	1, 4, 10	New York, N. Y.
Griffith, Isabella,	6	Harrisburg.
Griffith, Sallie,	3	Allentown.
Grove, LaVine,	6	Harrisburg.
Grubb, Percy L., B.A., (*Lehigh University.*)	7	Harrisburg.
Hafner, Gertrude,	4	Bethlehem.
Hammes, Anna Elda,	5	Bethlehem.
Hanlon, Mary,	3	Allentown.
Harlacher, J. E.,	6	Harrisburg.
Harrington, Carl E., M.E., (*Cornell University.*)	9	Buffalo, N. Y.
Harris, Mabel,	6	Harrisburg.
Hartzell, Ada,	6	Harrisburg.
Heberling, Ella Louisa,	4	Bethlehem.
Heckman, Elsie May,	3, 9	Allentown.
Heckman, Miriam,	3, 9	Allentown.

Heffner, Esther L.,	9	Allentown.
Heiges, W. C.,	6	Harrisburg.
Hemsath, Annie Elizabeth,	4	Bethlehem.
Henry, Harriet,	8	Nazareth.
Henry, Helen,	8	Nazareth.
Henschen, George, A.B., (*Johns Hopkins University.*)	7	Harrisburg.
Herritt, Olive J.,	3	Hazleton.
Hess, Mary Lucetta, A.B., (*Allentown College for Women.*)	12	Hellertown.
Higgins, Marie,	6	Harrisburg.
Hill, George, B.S., (*Pennsylvania College.*)	6	Harrisburg.
Hoch, Helena, A.B., (*Moravian College for Women.*)	10	Bethlehem.
Hocker, P. L.,	6	Harrisburg.
Hoffmeister, Mrs. Marian,	8	Bethlehem.
Hook, Clara,	6	Harrisburg.
Joffe, Mary,	6	Harrisburg.
Johnston, Helen,	6	Harrisburg.
Jones, Elsie M.,	4	Easton.
Kast, Bessie, A.B., (*Wellesley College.*)	7	Harrisburg.
Keiter, Anna,	6	Harrisburg.
Kennedy, Maude,	6	Harrisburg.
Kessler, Rose M.,	1, 7	Allentown.
Kessler, Hattie,	8	Nazareth.
Keys, Adelaide,	6	Harrisburg.
Knauss, Alice,	8	Nazareth.
Knecht, Mabel K.,	3	Allentown.
Knox, Elizabeth,	6	Harrisburg.
Kob, John,	6	Harrisburg.
Krall, Helen,	6	Harrisburg.
Kreidler, Ella,	8	Nazareth.
Kressler, Helen Rosemary,	5	Allentown.
Kressler, Ray H., A.B., (*Muhlenberg College.*)	1, 7	Allentown.
Lambert, Gertrude A.,	8	Bethlehem.
Lamond, Abigail,	6	Harrisburg.
Leist, Mary,	8	Mauch Chunk.
Lentz, Mrs. Horace D.,	8	Mauch Chunk.

Leonard, Eunice,	8	Mauch Chunk.
Lewis, Alfred Charles,	7	Allentown.
Lindsay, A. M., A.B., (*Lebanon Valley College.*)	7	Harrisburg.
Loch, Nevin T.,	1	Allentown.
Lubrecht, Anna C.,	3	Hazleton.
Lutz, Jennie,	6	Harrisburg.
McCullough, Harry Rath., A.B., (*Muhlenberg College.*)	1, 7	Allentown.
McLaughlin, Grace,	6	Harrisburg.
McNamara, John Joseph,	1	Bethlehem.
McNiff, Katherine, A.M., (*Columbia University.*)	7	Harrisburg.
Madera, Edna,	8	Mauch Chunk.
March, Bessie,	6	Harrisburg.
Markell, Helen,	6	Harrisburg.
Markle, Ella Evelyn,	4, 9	Easton.
Mayer, Rhedna,	6	Harrisburg.
Miller, Elmer F.,	1	Allentown.
Miller, Mrs. John,	8	Nazareth.
Miller, Lillie,	6	Harrisburg.
Miller, Mary,	8	Nazareth.
Moyer, Helen,	11	Bethlehem.
Murray, Anna Victoria,	4	Bethlehem.
Murray, Jeanette,	8	Bethlehem.
Murray, Marion,	8	Bethlehem.
Myers, Carrie,	6	Harrisburg.
Newhard, Stella,	3	Allentown.
Noll, Elizabeth,	3	Hazleton.
O'Connell, Anna,	6	Harrisburg.
O'Connell, Mary,	6	Harrisburg.
O'Donnell, Catherine,	3	Hazleton.
Orth, Mary, A.B., (*University of Chicago.*)	6	Harrisburg.
Owen, Bessie,	3	Hazleton.
Pendergast, Mary,	6	Harrisburg.
Pilz, Carrie,	8	Mauch Chunk.
Pohl, Elizabeth Shimer,	4, 9	Easton.
Pomp, William,	6	Harrisburg.
Purnell, Mildred Rose,	4, 9	Easton.
Rapp, Mary M.,	8	Mauch Chunk.

Reen, Mrs. Sarah,	6	Harrisburg.
Remel, Arling Milton,	1, 10	Bethlehem.
Ripple, Martha M.,	3	Hazleton.
Ritter, Florence May,		Allentown.
Roarty, Margaret A.,	3	Allentown.
Rose, Edward,	6	Harrisburg.
Roth, Mary C.,	3	Allentown.
Rundle, Jessie May,	4	Easton.
Ryan, Julia A.,	6	Harrisburg.
Ryan, M. Ella,	6	Harrisburg.
Rynard, Mary,	6	Harrisburg.
Saul, B. W., A.B., (*Otterbein University.*)	7	Harrisburg.
Saul, Isabel,	6	Harrisburg.
Schaefer, Emma,	3	Harrisburg.
Scharadin, Howard W.,	1, 7	Allentown.
Schlayer, Annie,	6	Harrisburg.
Schmidt, Mrs. Frank,	8	Nazareth.
Schneck, Helen Irene,	2	Allentown.
Schroeder, Julia A.,	5	Bethlehem.
Schumacher, Marian R.,	3	Hazleton.
Schumaker, John G., A.B., (*Muhlenberg College.*)	1, 2, 7, 9	Allentown.
Schwaninger, Mary Alice, A.B., (*Goucher College.*)	12	Allentown.
Sechrist, Helen,	2	Allentown.
Segelbaum, Clara, A.B., (*Irving College.*)	7	Harrisburg.
Smith, Millie,	3	Hazleton.
Solt, Ada May,	4	Bethlehem.
Spatz, E. Margaret,	3	Allentown.
Stambaugh, Elda,	6	Harrisburg.
Steinheiser, Mabel,	8	Mauch Chunk.
Strohmeier, Adella,	9	Easton.
Stroup, Mary,	6	Harrisburg.
Sullivan, Margaret,	6	Harrisburg.
Tatnal, Edith, A.B., (*Dickinson College.*)	7	Harrisburg.
Tatnal, Grace, (*Pennsylvania College for Women.*)	7	Harrisburg.
Thomas, George Edward,	7	Allentown.

Thomas, H. H.,	6	Harrisburg.
Thompson, Isabel,	8	Mauch Chunk.
Tinker, William Marsh, B.A., B.D., (*Thiel College, Yale University.*)	7	Allentown.
Tittle, A. May,	6	Harrisburg.
Tittle, Elizabeth,	6	Harrisburg.
Twining, Mrs. William,	8	Mauch Chunk.
Twining, Evelyn,	8	Mauch Chunk.
VanDyke, Ella Rebecca,	4	Bethlehem.
Villee, Sallie,	5	Bethlehem.
Walser, Anna,	6	Harrisburg.
Walser, Ruth,	6	Harrisburg.
Weida, Emma C.,	3	Allentown.
Weida, Esther,	11	Emaus.
Weil, Emma Catherine,	4	Bethlehem.
Weills, William Edgar, B.S., (*University of Pennsylvania.*)	7	Allentown.
Weirbach, T. Mahlon, A.B., (*University of Michigan.*)	1, 7	Allentown.
Weirick, Iva,	6	Harrisburg.
Weiser, Abby Catherine,	5	Bethlehem.
Wentz, Herbert Homer, B.S., (*Muhlenberg College.*)	1, 7	Allentown.
Wert, Anne, A.M., (*Pennsylvania College for Women.*)	7	Harrisburg.
Wessner, Anna E., B.S., (*Teachers' College.*)	7	Allentown.
Williams, Ada,	3	Hazleton.
Williams, Blanche,	8	Bethlehem.
Williams, J. Henry,	6	Harrisburg.
Wright, Mrs. Arthur Holmes,	10	Allentown.
Wunderly, Mrs. Paul,	8	Nazareth.
Wuschlitz, Nettie,	8	Mauch Chunk.
Zeiders, Katherine, A.B., (*George Washington University.*)	7	Harrisburg.
Ziegenfuss, Warren Allen, A.B., (*Muhlenberg College.*)	1, 2, 7	Allentown.
Zimmerman, Annie,	6	Harrisburg.
Zimmerman, George Wentling,	1, 7	Allentown.
Zimmerman, Grace B.,	3, 9	Allentown.
Zweibel, Stanley A.,	1, 9	Bethlehem.

LIST OF VOCATIONAL STUDENTS

B.M.—Battery Mechanics
Car.—Carpentry
Con.—Concrete Work
C. —Cooking
E.T.—Electrical Trades
L.E.—Locomotive Engineering
L.F.—Locomotive Firing
R.C.—Road Construction
R.R.—Railroad Track Work
Tel.—Telegraphy

Name	Course	Group	Address
Abbott, Frank Samuel,	L.E.,	2	Carnegie.
Acors, Harvey Leonard,	Con.,	1	Goodloes, Va.
Adair, Ernest Montrose,	L.E.,	2	Tracy, Cal.
Adams, Clarence Linwood,	B.M.,	1	Lynchburg, Va.
Adelson, Ben,	Tel.,	2	Wilkes-Barre.
Albright, Harry James,	B.M.,	3	Philadelphia.
Alcorn, Richard H.,	Tel.,	1	Patoka, Ind.
Aldrich, Percy W.,	B.M.,	3	Milford.
Alessandroni, John,	B.M.,	3	Philadelphia.
Alexander, Robert B.,	Tel.,	2	Wilkes-Barre.
Allard, Walter E.,	R.C.,	1	Norfolk, Va.
Allen, Donald B.,	R.C.,	1	Bridgewater, Va.
Almond, James Arthur,	B.M.,	1	Richmond, Va.
Anderson, Fred Eugene,	L.F.,	2	Madisonville.
Anderson, William James,	Tel.,	3	Pottstown.
Angle, William Riley,	B.M.,	1	Simpsons, Va.
Archer, Wilfred John,	B.M.,	3	Pittsburgh.
Arsenault, Edgar J.,	Tel.,	1	Fall River, Mass.
Ashby, John W.,	Tel.,	2	Bloomfield, Ontario, Canada.
Ashcraft, Bernard Alfred,	E.T.,	2	Coudersport.
Asher, Ralph Hays,	L.E.,	2	London, Ohio
Aton, George James,	L.F.,	2	Ashley.
Auman, George Emmett,	L.F.,	3	Shamokin.
Aurelius, Ernest Emanuel,	L.E.,	2	St. Paul, Minn.
Ayers, Grady W.,	E.T.,	1	Bedford, Va.
Babcock, Lawrence,	B.M.,	3	Tunkhannock.
Bacchini, Adolph,	L.E.,	2	San Francisco, Cal.
Bach, George J.,	Tel.,	1	Hoboken, N. J.
Bachmann, John A.,	Tel.,	2	Mt. Oliver.
Bagley, Charles W.,	C.,	1	Petersburg, Va.
Baicker, Isaac J.,	Tel.,	1	Nanticoke.

Baker, Arthur Franklin,	L.E.,	2	Dorchester, Mass.
Baker, Earl,	Tel.,	2	Peconie, N. Y.
Ballew, Sidney E.,	R.R.,	1	Mint Springs, Va.
Balling, George Alphonse,	R.C.,	2	Howard Beach, N. Y.
Ballou, Ashley F.,	Tel.,	2	Buffalo, N. Y.
Bambach, Elmer Armin,	B.M.,	3	Scranton.
Bamback, John Jacob,	L.E.,	2	Scranton.
Bankert, Jairus Franklin,	L.F.,	3	Spring Grove.
Banton, Alto W.,	C.,	2	Melita, Va.
Barber, William Adelbert,	L.E.,	2	Bessemer.
Barbour, John S.,	R.C.,	1	Roanoke, Va.
Barclay, William F.,	Tel.,	1	Pittsburgh.
Barley, John Trent,	Tel.,	1	South Boston, Va.
Barnhouse, Clifford C.,	L.E.,	1	Fairfield, Ill.
Baron, Charles George,	E.T.,	2	Fredonia, N. Y.
Barron, Philip Joseph,	B.M.,	3	Philadelphia.
Barry, Raymond H.,	Tel.,	2	Greenville.
Bartinikas, William Stanlish,	B.M.,	1	Roanoke, Va.
Basham, Jesse Lee,	B.M.,	1	Roanoke, Va.
Bass, Arthur F.,	Tel.,	1	South Richmond, Va.
Bass, Walter P.,	Tel.,	1	Lynchburg, Va.
Bates, Morton,	L.E.,	2	Wellsville, Ohio.
Batt, Percy George,	Tel.,	1	Parma, Idaho.
Bauer, Carl G.,	Tel.,	1	Toledo, Ohio.
Bauer, William W.,	Con.,	2	Wilkes-Barre.
Bauman, Irvin,	L.F.,	1	Roanoke, Va.
Baxley, Howard Allen,	L.E.,	2	Carrollton, Texas.
Beard, John Edward,	L.E.,	2	Bellwood.
Beattes, Horace R.,	B.M.,	2	Philadelphia.
Beck, Jacob Paul,	B.M.,	3	Philadelphia.
Becker, David,	Tel.,	2	Brooklyn, N. Y.
Becker, Leon John,	R.C.,	2	Wilkes-Barre.
Beckerman, Peter M.,	C.,	2	Wayland, N. Y.
Bell, Chester G.,	B.M.,	2	Buffalo, N. Y.
Bell, Vincent Gruber,	R.C.,	2	Wilkes-Barre.
Belles, Carl Ervin,	B.M.,	3	Benton.
Belnoski, John,	Tel.,	1	Nanticoke.
Bendixsen, Paul,	Tel.,	1	Williston, N. D.
Berg, Raymond,	Tel.,	2	Wilkes-Barre.

Berger, George W.,	Tel.,	2	Hastings-on-Hudson, N. Y.
Berkhimer, Harry,	B.M.,	3	Duncansville.
Berlin, Ellsworth George,	E.T.,	2	Philadelphia.
Bernander, Eric A.,	Tel.,	2	Batavia, N. Y.
Berndt, Edward A.,	Car.,	2	Rochester, N. Y.
Berner, Clarence Elmer,	R.C.,	2	Clearfield.
Berns, George W.,	C.,	2	Reading.
Berry, Childs Erwin,	B.M.,	1	Richmond, Va.
Barry, Paul Ellison,	B.M.,	1	Norfolk, Va.
Bevitch, Andrew W.,	C.,	2	Reading.
Bezem, Saul,	Car.,	2	New York, N. Y.
Bidwell, Clyde Edward,	B.M.,	3	Plains.
Bierbower, Hugh F.,	L.E.,	1	New Kingston.
Bigger, William,		2	Hilton, N. Y.
*Bines, Ray C.,	B.M.,	3	Clarendon.
Birch, George,	L.F.,	2	Erie.
Bishop, Carroll Ernest,	E.T.,	2	Warrenton, Va.
Bisker, James A.,	Tel.,	1	Princeton, Ind.
Blackburn, Ernest,	B.M.,	2	Millvale.
Blain, Pirie D.,	Tel.,	2	St. Catharine's, Ontario, Canada.
Blaylock, Sim M.,	C.,	1	Ettrick, Va.
Blumer, Henry,	Tel.,	1	York.
Boatman, Ernest R.,	Tel.,	1	Claremont, Ill.
Boaz, Herman W.,	L.F.,	1	Galax, Va.
Boehly, Bernard,	Tel.	2	Rochester, N. Y.
Boggess, Riffe,	Tel.,	1	Richlands, Va.
Boggs, Benjamin H.,	Tel.,	2	Harrisburg.
Bohan, Charles,	L.E.,	1	Chicago, Ill.
Bomberger, John M.,	Tel.,	2	Lebanon.
Bornholdt, William F.,	C.,	2	Brooklyn, N. Y.
Bostian, Paul N.,	B.M.,	2	West Milton.
Bourne, George,	B.M.,	1	Blackstone, Va.
Bowden, James Lester,	B.M.,	3	Philadelphia.
Bower, John Franklin,	B.M.,	3	Shamokin.
Bowles, Thomas E.,	E.T.,	1	Portsmouth, Va.
Bowmaster, Ralph William,	L.F.,	3	Meyersdale.
Boyer, George Franklin,	B.M.,	3	Hanover.
Boyer, Lester Harold,	L.E.,	2	Turburville.
Brace, Gilbert F.,	L.E.,	1	Albion.

*Died October 24, 1918.

Bradford, Louis S.,	B.M.,	2	Philadelphia.
Bradley, John Joseph,	Tel.,	3	Norristown.
Bragg, Albert Frank,	B.M.,	3	Sharpsburg.
Braithwaite, Fred,	L.F.,	1	Cross Junction, Va.
Bramer, Roy Charles,	L.E.,	2	Green Bay, Wis.
Brandis, Philip J.,	Tel.,	2	Philadelphia.
Brandt, Charles Z.,	E.T.,	2	Brooklyn, N. Y.
Branner, Clarence Augustus,	B.M.,	1	Broadway, Va.
Bratton, Clifford James,	B.M.,	3	Tyrone.
Brenneman, Daniel Andrew,	L.F.,	3	York.
Brent, Joseph Francis,	Tel.,	3	Pittsburgh.
Brewer, William H.,	Tel.,	1	Danville, Va.
Bright, Newman John,	B.M.,	3	Warren.
Bright, William C.,	Tel.,	1	Portsmouth, Va.
Brislin, James B.,	B.M.,	2	Wilkes-Barre.
Broadstein, Morris,	Con.,	2	Philadelphia.
Brooking, Thomas N.,	Tel.,	1	Orange, Va.
Broome, Harold Kenworthy,	Tel.,	3	Philadelphia.
Brothers, Fred W.,	L.E.,	1	Clay City, Ind.
Brown, Albert Vernon,	B.M.,	3	Philadelphia.
Brown, Robert Joseph,	L.E.,	2	Springfield, Ill.
Brown, William E.,	Tel.,	1	Pueblo, Colorado.
Brumbach, Charles M.,	Tel.,	2	Philadelphia.
Brutting, John C.,	Tel.,	2	White Plains, N.Y.
Bucher, Joseph G.,	C.,	2	Philadelphia.
Burger, Rolland T.,	Tel.,	1	Healing Spring, Va.
Burgess, DeForrest L.,	C.,	2	Oneonta, N. Y.
Burkhardt, George W.,	E.T.,	2	Philadelphia.
Burman, Dean,	B.M.,	3	Williamsport.
Burnish, William B.,	Con.,	2	Reading.
Burns, Daniel J.,	L.E.,	1	Brillion, Wis.
Burns, George Edward,	R.C.,	2	Scranton.
Burstein, Meyer,	B.M.,	3	Pittston.
Burton, Marx Henry,	L.E.,	2	Bluefield, W. Va.
Buskell, Arthur M.,	E.T.,	1	Richlands, Va.
Butzke, Alex F.,	Tel.,	1	Milwaukee, Wis.
Cahill, Edward Michael,	B.M.,	3	Philadelphia.
Caldwell, William James,	Tel.,	3	New Castle.
Call, Joseph John,	L.F.,	3	Philadelphia.
Callahan, Matthew,	Tel.,	2	State Run.

Callahan, Walter M.,	E.T.,	1	Norfolk, Va.
Calvert, Robert A.,	Tel.,	1	Hoadley, Va.
Campbell, David Edward,	L.E.,	2	Wilmington, Del.
Carico, William N.,	R.C.,	1	Colburn, Va.
Caris, Perry A.,	Tel.,	2	Muncy.
Carl, James A.,	Tel.,	1	Kalamazoo, Mich.
Carman, Anthony Jay,	L.E.,	2	Mason City, Iowa.
Carmody, Jerry James,	L.F.,	2	Kingston.
Carr, McCauley,	Tel.,	1	Denver, Col.
Carson, John,	Tel.,	1	Denver, Col.
Carter, Norval Ward,	B.M.,	1	Berryville, Va.
Carter, William Addison,	B.M.,	1	Roanoke, Va.
Cartwright, Charles A.,	Tel.,	1	Norfolk, Va.
Cartwright, Stephen M.,	L.E.,	1	Norfolk, Va.
Case, Homer F.,	B.M.,	2	Buffalo, N. Y.
Case, Thomas E.,	L.F.,	1	Horse Shoe, N. C.
Casper, William P.,	B.M.,	2	Shamokin.
Catcher, John,	R.R.,	2	Ramey.
Chapelle, Fred H.,	L.E.,	1	Ponca, Neb.
Chapman, Albert F.,	Tel.,	2	Amsterdam, N. Y.
Chesnut, Gorman R.,	B.M.,	2	Milton.
Chichester, Harry D.,	Tel.,	1	Altoona.
Chitty, Bernard P.,	E.T.,	1	Norfolk, Va.
Chrabot, Ladislaus A.,	Tel.,	1	LaSalle, Ill.
Churchfield, Homer B.,	Con.,	2	Wall.
Churchfield, John R.,	Con.,	2	Wall.
Clark, Albert,	Tel.,	2	Nanticoke.
Clark, Charles H.,	Tel.,	2	Rochester, N. Y.
Clark, Homer Lee,	B.M.,	3	Washington.
Clark, Walter,	B.M.,	3	Philadelphia.
Claypool, Robert Ivan,	L.E.,	1	Saybrook, Ill.
Clifford, Charles,	Tel.,	2	Oil City.
Cline, Harold H.,	L.E.,	1	Williamsport.
Clinton, Jesse Lewis,	B.M.,	1	Portsmouth, Va.
Cloyd, Allen E.,	E.T.,	1	Dublin, Va.
Cobb, Slade Franklin,	B.M.,	1	Danville, Va.
Cohan, Percy,	L.F.,	2	Philadelphia.
Cole, Wrightson Octavius,	Tel.,	3	York.
Coleman, Charles Palmer,	R.R.,	2	Beaver Springs.
Colgate, James Thomas,	B.M.,	1	Drake's Branch, Va.

Collins, James E.,	Tel.,	1	Richmond, Va.
Conditt, Clint,	L.E.,	2	Shawneetown, Ill.
Conklin, James Forest,	B.M.,	3	Washington.
Conley, Claude Bernard,	E.T.,	2	Ridgway.
Connolly, Francis J.,	Tel.,	1	Troy, N. Y.
Connolly, Terrence Francis,	R.C.,	2	Germantown.
Conner, Joseph J.,	Tel.,	2	Philadelphia.
Connor, Walter Sutton,	L.E.,	2	Norwood, Ohio.
Conrad, Max H.,	L.F.,	1	Evergreen Park, Ill.
Cook, William C.,	B.M.,	2	McKeesport.
Cooke, Lewis B.,	E.T.,	1	Richmond, Va.
Cooper, Arthur J.,	Tel.,	2	Scranton.
Cooper, George Holday,	B.M.,	1	Norfolk, Va.
Cope, Stuart Morton,	L.F.,	2	Sunbury.
Corak, Henry Gottlieb,	E.T.,	2	Philadelphia.
Corcoran, Ivan S.,	Tel.,	1	Milwaukee, Wis.
Coughlin, Milward Andrew,	L.E.,	2	Chicago, Ill.
Courter, Ralph W.,	Tel.,	2	Buffalo, N. Y.
Craig, John Lester,	Tel.,	3	Wanamie.
Creamer, Benjamin Franklin,	B.M.,	3	Gaysport.
Crumley, Thomas Edward,	L.E.,	2	Chesterton, Ind.
Crute, John L.,	B.M.,	1	Scottsburg, Va.
Cunningham, Joseph,	Tel.,	2	Philadelphia.
Curran, Clay C.,	Tel.,	1	Cannon Falls, Minn.
Curran, Joseph Francis,	L.E.,	2	Los Angeles, Cal.
Currier, Douglass,	E.T.,	2	Bethlehem.
Curry, Arthur,	Tel.,	2	Pittsburgh.
Curtin, Benjamin F.,	L.E.	1	Alexandria, Va.
Curtis, John R.,	Tel.,	2	Nanticoke.
Dailey, James L.,	C.,	2	Whitacre, Va.
Damario, Joseph,	Tel.,	2	Reading.
Dance, Frank Warren,	B.M.,	1	Houston, Va.
Davin, Stephen Peter,	Tel.,	3	York Haven.
Davis, Henry McClelland,	R.R.,	2	Saxburg.
Davis, Joseph James,	L.E.,	2	Bellefonte.
Davis, Ray E.,	Tel.,	2	Cressona.
Davis, Robert E.,	E.T.,	1	Norfolk, Va.
Davis, William Albrecht,	E.T.,	2	Harrisburg.
Davis, William J.,	Tel.,	2	Syracuse, N. Y.
Davis, Winthrop H.,	Tel.,	1	Richmond, Va.

Dawley, William L.,	B.M.,	1	Norfolk, Va.
Dean, Chauncey H.,	Tel.,	2	New Castle.
Deck, Earl Ruben,	Tel.,	3	Franklin.
Derman, Benjamin,	Car.,	2	Buffalo, N. Y.
Devlin, John,	C.,	1	Bethlehem.
DeVoe, Harry Webb,	B.M.,	3	Woodbine.
Dexter, Horace Everett,	L.E.,	2	North Scituate, R. I.
Deysher, Warren H.,	Con.,	2	Reading.
Diamond, Franklin Francis,	B.M.,	3	Bridgeport.
Dickel, Frederick,	Tel.,	2	Philadelphia.
Dickens, Eugene Colman,	B.M.,	1	Houston, Va.
Dietrich, Lawrence Bernard,	R.C.,	2	Philadelphia.
Dietrick, Harold Edward,	E.T.,	2	Olyphant.
Ditri, Paolo,	B.M.,	3	Philadelphia.
Dittman, Harold G.,	B.M.,	2	Buffalo, N. Y.
Ditz, Leo Michael,	R.C.,	2	Fryburg.
Dixon, William R.,	Tel.,	2	East Stroudsburg.
Dodson, Carroll L.,	R.R.,	1	Sperryville, Va.
Doell, Arthur,	B.M.,	2	Brooklyn, N. Y.
Dolby, Eugene Edward,	B.M.,	3	Oil City.
Dominici, Roland W.,	Tel.,	1	Richmond, Va.
Donahue, Harold P.,	Con.,	2	Buffalo, N. Y.
Donegan, James Joseph,	L.F.,	2	Holyoke, Mass.
Doty, Asa L.,	B.M.,	2	West Falls, N. Y.
Doty, Clifford F.,	Tel.,	1	Elkhart, Ind.
Doutrich, Paul Erb,	Tel.,	3	Harrisburg.
Doyle, Thomas F.,	Tel.,	2	Pittston.
Doyle, William John,	B.M.,	3	Philadelphia.
Driscoll, James Francis,	L.F.,	3	Connellsville.
Duff, Alaster Ward,	R.C.,	2	Mahaffey.
Duffie, Ralph G.,	L.E.,	1	Ludlow, Ky.
Dugan, Neal Michael,	R.C.,	2	Olean, N. Y.
Duncan, Jeremiah Warren,	B.M.,	3	Philadelphia.
Dunnigan, John Joseph,	R.C.,	2	Wilkes-Barre.
Durnell, Edward Lyle,	B.M.,	3	Franklin.
Dwyer, Clifford F.,	Tel.,	2	Hudson Falls, N. Y.
Eaton, Harold L.,	Tel.,	1	Armstrong, Iowa.
Eckert, George V.,	L.F.,	1	Haubstadt, Ind.
Egan Harold Francis,	Tel.,	3	Blossburg.
Eggers, Gus Ernest,	L.E.,	2	Whiting, Ind.

Eggert, George J.,	L.E.,	1	Chicago, Ill.
Ehlers, William W.,	E.T.,	2	Pittsburgh.
Ehrlich, Jacob C.,	B.M.,	2	Philadelphia.
Eikey, George,	Tel.,	1	Traverse City, Mich.
Elf, Carl Martin,	B.M.,	3	Oil City.
Eller, John Edward,	L.F.,	3	Erie.
Elliott, Wyatt A.,	R.R.,	1	Petersburg, Va.
Enloe, David A.,	L.E.,	1	Kansas City, Mo.
Entenman, Jacob,	Car.,	2	Rocks, N. Y.
Erickson, William Everett,	Tel.,	3	McKeesport.
Erisman, Abram P.,	B.M.,	3	Lancaster.
Etter, Herbert Snider,	Tel.,	3	Marion.
Evans, Everette V.,	Tel.,	1	Birmingham, Ala.
Evans, Louis M.,	Tel.,	1	Hopewell, Va.
Evans, Ralph Henry,	R.C.,	2	Ebensburg.
Evans, William Benjamin,	B.M.,	3	Scranton.
Everett, Henry,	Tel.,	2	Stottville, N. Y.
Ewing, Clark L.,	Tel.,	1	Coldwater, Ohio.
Fagan, James Sylvester,	B.M.,	3	Wilkes-Barre.
Fannie, Lonnie W.,	C.,	1	Portsmouth, Va.
Farne, John Morrison,	Tel.,	3	St. Clair.
Farrand, Arthur J.,	L.E.,	2	Benton Harbor, Mich.
Farrell, Edward P.,	L.E.,	1	Oneida, Ohio.
Farrington, William S.,	Con.,	2	Philadelphia.
Feldman, Harry,	R.C.,	2	Philadelphia.
Fichter, Edward P.,	B.M.,	2	Reading.
Fick, Clarence R.,	Tel.,	2	Reading.
Field, Howard C.,	Tel.,	1	New Haven, Conn.
Field, Walter Clarence,	L.F.,	3	Powell.
Fields, Conrad J.,	B.M.,	2	Philadelphia.
Fink, Mearl McKinley,	L.F.,	3	Mount Wolf.
Firestein, Harry Lewis,	B.M.,	3	Pittston.
Fischl, Adolph,	L.E.,	2	Helena, Mont.
Fisher, Charles M.,	E.T.,	2	Williamsport.
Fisher, Fred Stuckey,	B.M.,	3	McConnellsburg.
Flanagan, Stephen James,	L.E.,	2	Pittsburgh.
Fleener, Millard J.,	Tel.,	1	Princeton, Ind.
Fleisner, Harry August,	L.E.,	2	Mount Oliver.
Fletcher, William,	C.,	1	Standardsville, Va.

Floyd, John Marshall,	B.M.,	3	Miners Mills.
Floyd, Richard M.,	C.,	1	Danville, Va.
Foley, Michael W.,	B.M.,	2	Pittsburgh.
Foote, Joseph Moore,	B.M.,	3	Parsons.
Ford, William Richardson,	B.M.,	1	Richmond, Va.
Forney, Sam. V.,	R.C.,	1	Pulaski, Va.
Forrest, Tedoc A.,	Tel.,	1	Vanceboro, N. C.
Foss, Fred E.,	L.E.,	2	Pasadena, Cal.
Foster, Hugh M.,	Tel.,	1	Roanoke, Va.
Fote, Sebastian,	B.M.,	2	Philadelphia.
Fox, Russell R.,	R.R.,	1	Greenwood, Va.
Frabotta, John B.,	L.F.,	1	Cleveland, Ohio.
Frank, Frederick Peter,	R.C.,	2	Wilkes-Barre.
Freeberg, Carl Alden,	L.E.,	2	West Duluth, Minn.
Frey, Russell Charles,	E.T.,	1	Allentown.
Frish, Raymond John,	R.R.,	2	Sheridan.
Fruhlinger, Jacob,	Tel.,	2	Johnstown.
Fuget, Preston Paul,	B.M.,	3	Harrisburg.
Fultz, Isaac,	B.M.,	1	Fairfield, Va.
Gabriel, Edward Jacob,	B.M.,	3	Philadelphia.
Gackenbach, Arthur F.,	E.T.,	1	Allentown.
Gaffney, Joseph John,	R.C.,	2	Saratoga, N. Y.
Gajer, Ervin A.,	Tel.,	1	Fairmount, N. D.
Galarneau, George V.,	B.M.,	2	Montreal, Quebec, Canada.
Galladay, Samuel M.,	L.F.,	1	Buffalo Station, Va.
Gallagher, Walter Nathaniel,	L.F.,	3	Philadelphia.
Gardner, Harry F.,	Con.,	2	Freeport.
Garren, James J.,	L.E.,	1	Cleveland, Ohio.
Garrity, Benjamin Lloyd,	B.M.,	3	Erie.
Garth, Leonard A.,	Tel.,	1	Ivey Depot, Va.
Gault, George G.,	Tel.,	2	Dawson.
Gebhart, Lester Elliot,	B.M.,	3	Bellwood.
Geer, Andrew J.,	Tel.,	2	Rochester, N. Y.
Gemmer, Harmon M.,	L.E.,	1	Huntington, Ind.
Gentry, Irvin W.,	L.F.,	1	Port Norfolk, Va.
Gerber, Harry,	L.E.,	1	Dalston, London, England.
Gerhardt, Reinhart Carl,	Tel.,	3	Archbald.
Germelman, Henry L.,	B.M.,	1	Richmond, Va.
Gilbert, William B.,	R.R.,	1	Buchanan, Va.

Gilmer, George E.,	Tel.,	2	Philadelphia.
Ginkel, Francis,	Tel.,	2	Fryburg.
Glennan, James Patrick,	L.F.,	3	Shamokin.
Godwin, Richard Thomas,	B.M.,	1	Norfolk, Va.
Goff, George C.	Tel.,	1	Norfolk, Va.
Goggin, Harry T.,	R.C.,	1	Pen Hook, Va.
Gold, Louis J.,	Tel.,	2	Rochester, N. Y.
Golden, Byron Joseph,	E.T.,	2	Peckville.
Goldman, Herman,	C.,	2	Philadelphia.
Gollody, Samuel M.,	L.E.,	1	Buffalo Station, Va.
Gooding, Arch Clayton,	B.M.,	3	Knoxville.
Gordon, Wallace W.,	L.E.,	2	West Concord, Minn.
Gorman, Francis A.,	Con.,	2	Philadelphia.
Gorman, Francis J.,	Con.,	2	Philadelphia.
Gorman, Frank T.,	Tel.,	2	Girardville.
Graff, Charles J.,	Tel.,	2	Pittsburgh.
Gray, Arthur J.,	B.M.,	2	Yonkers, N. Y.
Gray, John F.,	Tel.,	2	Philadelphia.
Green, Michael Joseph,	B.M.,	1	Norfolk, Va.
Greene, Harry Oscar,	B.M.,	3	Rouseville.
Greenstein, Benjamin,	Tel.,	2	New York, N. Y.
Greiner, Frank John,	B.M.,	3	Erie.
Gribbon, William Edward,	E.T.,	2	Pittsburgh.
Griffith, David,	C.,	2	Scranton.
Grubbs, William I.,	Tel.,	1	Richmond, Va.
Grudis, William,	L.E.,	2	Scranton.
Guentner, Anthony E.,	C.,	2	Millvale.
Guess, Fred M.,	Tel.,	1	Woodstock, Va.
Gushman, Henry H.,	C.,	2	Philadelphia.
Guttendorf, George C.,	B.M.,	2	Pittsburgh.
Gwynn, Lloyd Linwood,	B.M.,	1	Norfolk, Va.
Haggard, William Wilt,	L.E.,	2	Salina, Kansas.
Hagmaier, Edward,	L.F.,	2	Pittsburgh.
Haight, Francis E.,	B.M.,	2	Warrensburg, N. Y.
Hale, Ernest Russell,	Tel.,	3	Yatesville.
Hall, Clayton B.,	Tel.,	2	Albany, N. Y.
Hall, George,	B.M.,	2	McKeesport.
Hall, James T.,	Tel.,	1	Danville, Va.
Halverson, Benjamin,	Tel.,	1	Milwaukee, Wis.
Hambly, Ray Wesley,	E.T.,	2	Honesdale.

Hamilton, Joseph,	L.E.,	2	Denver, Col.
Hamilton, Robert M.,	B.M.,	2	Turtle Creek.
Hanks, Flem Cecil,	B.M.,	1	Max Meadows, Va.
Hanlon, Bartholomew C.,	L.E.,	1	Olyphant.
Hannigan, Joseph Walter,	B.M.,	3	Philadelphia.
Hansen, Anthony Nelson,	R.C.,	2	Utica, N. Y.
Harding, Edwin B.,	Tel.,	1	Grand Rapids, Wis.
Harenski, Joseph A.,	Tel.,	2	Pittsburgh.
Harlacher, Lloyd C.,	E.T.,	1	Allentown.
Harney, John E.,	B.M.,	2	Altoona.
*Harnish, Raymond B.,	Tel.,	3	Mount Joy.
Harper, Herman,	R.R.,	2	Fountain, Fla.
Harper, Walter Nichols,	R.R.,	2	Troy, N. Y.
Harris, Ernest P.,	L.F.,	1	Charlottesville, Va.
Harris, George E.,	Con.,	2	Peckville.
Harris, Hyman L.,	Tel.,	1	Portsmouth, Va.
Harris, Lucian M.,	L.F.,	1	Roanoke, Va.
Harris, Robert L.,	E.T.,	1	Bedford, Va.
Harris, Seldon Herman,	B.M.,	1	Marion, Va.
Harsh, Amos Urich,	R.C.,	2	Pittsburgh.
Hartman, Fred Allen,	B.M.,	3	Hanover.
Harvell, Evan R.,	R.R.,	1	Norfolk, Va.
Hash, Patrick A.,	Tel.,	1	Gate City, Va.
Hastie, John A.,	Tel.,	2	Freeport.
Hatten, Walter James,	B.M.,	3	Du Bois.
Hays, James H.,	L.E.,	1	McKeesport.
Hearne, Edward,	E.T.,	2	Pittsburgh.
Hedrick, John W.,	R.R.,	1	Bane, Va.
Hefferman, John F.,	Tel.,	2	Philadelphia.
Hefner, James M.,	L.E.,	2	Amarillo, Tex.
Heinel, Arnold,	B.M.,	2	Glendale, N. Y.
Heintzleman, Hoyt Melvin,	L.F.,	3	Middleburg.
Hemphill, Boyd,	B.M.,	3	Philadelphia.
Henderson, John B.,	R.C.,	1	Thessalia, Va.
Henderson, Leslie E.,	R.C.,	1	Thessalia, Va.
Henley, Kenneth P.,	Tel.,	1	Ocean View, Va.
Hennigan, Ambrose,	Con.,	2	Pittston.
Henning, Otto A.,	L.E.,	1	Chicago, Ill.
Henry, James J.,	Tel.,	2	Glendale, N. Y.
Herbert, Clyde,	L.E.,	1	Dawson.
Herman, Philip,	Tel.,	3	York.

*Died November 5, 1918.

Hess, Lambert Joseph,	B.M.,	3	Pottsville.
Hicks Charles Robert	L.F.,	3	Chambersburg.
Hicks, Otho W.,	R.R.,	1	Franklinton, N. C.
Higgins, John J.,	Tel.,	2	Scranton.
Higgins, Lawrence William,	Tel.,	3	Sharon.
Hill, Edmund Allen,	R.C.,	2	Germantown.
Hill, Howard Clayton,	E.T.,	2	Bedford.
Hilliard, Paul B.,	Tel.,	1	Dumbarton, Va.
Hoch, Herbert Lee,	R.C.,	2	Kittanning.
Hochstetler, Eli E.,	L.F.,	2	Phoenix, Ariz.
Hockman, Oscar L.,	Tel.,	1	Fairfield, Va.
Hodge, Daniel Edward,	L.E.,	2	Livingston, Mont.
Hoeger, Clement A.,	B.M.,	2	Philadelphia.
Hoffman, Alfred Theodore,	B.M.,	3	McKeesport.
Hoffman, Hugo,	B.M.,	2	Philadelphia.
Hoke, Edward Charles,	B.M.,	3	Newport.
Holka, George J.,	L.E.,	1	Chicago, Ill.
Holland, Zachariah Everet,	B.M.,	1	Holland, Va.
Holliday, Fred T.,	E.T.,	1	Pulaski, Va.
Holmes, Clifford H.,	Car.,	2	Lisle, N. Y.
Holmes, Harry L.,	Tel.,	1	Minneapolis, Minn.
Honeywell, Ernest Welton,	B.M.,	3	Kingston.
Hoover, Harrison E.,	B.M.,	2	Harrisburg.
Hoover, Leonard David,	B.M.,	3	Edenburg.
Hopkins, Richard J.,	B.M.,	2	Pittsburgh.
Horan, Raymond Joseph,	Tel.,	3	Wilkes-Barre.
Hornberger, Hiester Richard,	R.C.,	2	Sinking Springs.
Hornung, William L.,	B.M.,	2	Rochester, N. Y.
Hosack, Howard Milton,	B.M.,	3	Oil City.
Howells, James Trevor,	B.M.,	3	Wilkes-Barre.
Hreno, John,	B.M.,	3	Wilkes-Barre.
Hricko, Michael James,	L.F.,	3	Dickson.
Huffman, Marshall Stuart,	B.M.,	1	Roanoke, Va.
Hughes, Edward R.,	L.E.,	1	Benwood, W. Va.
Hughes, Francis Patrick,	E.T.,	2	Schellburg.
Hughes, John Owen,	L.E.,	2	Winona, Minn.
Hughes, William F.,	R.R.,	1	Danville, Va.
Hundley, Allen R.,	R.R.,	1	Elliston, Va.
Hursh, James Hartley,	B.M.,	3	Philadelphia.
Hyde, McFreeman,	Tel.,	1	Niangua, Mo.
Imboden, Ralph S.,	Tel.,	2	Lebanon.

Inghram, Paul D.,	Tel.,	2	Waynesburg.
Ingram, Bernard James,	B.M.,	3	Philadelphia.
Isaacs, Arthur,		2	Brooklyn, N. Y.
Isinger, James W.,	B.M.,	2	Paoli.
Irvin, Bernard Francis,	B.M.,	3	Eldorado.
James, Ralph E.,	Tel.,	2	Johnstown.
Jamison, Lewis,	C.,	2	Chester.
Jarolem, Harry,	Tel.,	2	New York, N. Y.
Jeffords, Claude L.,	Tel.,	2	Schuylerville, N.Y.
Jenkins, Harry,	E.T.,	2	Scranton.
Jerome, Charles H.,	Tel.,	2	Philadelphia.
Jewett, Carlton B.,	Tel.,	1	Portsmouth, Va.
Johanson, Hilmer R.,	Tel.,	1	Everett, Wash.
John, Hugh W.,	B.M.,	2	Shamokin.
Johnson, Edward E.,	Tel.,	2	Brooklyn, N. Y.
Johnson, Howard Leroy,	E.T.,	2	Canandaigua, N.Y.
Johnson, James H.,	Tel.,	2	Philadelphia.
Johnson, Joseph Alexander,	B.M.,	1	Richmond, Va.
Johnson, Malcolm T.,	R.R.,	2	Ashley.
Johnson, Oscar,	B.M.,	3	Philadelphia.
Johnson, Robert E.,	Tel.,	2	Carnegie.
Johnson, Victor E.,	Tel.,	1	Sioux City, Iowa.
Jones, Claude P.,	Tel.,	2	Wilkes-Barre.
Jones, Edwin C.,	Tel.,	1	Vincennes, Ind.
Jones, George Edward,	R.C.,	2	Lebanon.
Jones, Ivor,	C.,	2	Wilkes-Barre.
Jones, Morgan Boatwright,	Con.,	1	Ore Bank, Va.
Jones, Perlie W.,	R.C.,	1	Galax, Va.
Jones, Samuel K.,	Car.,	2	Philadelphia.
Jones, William R.,	B.M.,	2	Wilkes-Barre.
Joseph, David John,	R.R.,	2	Wilkes-Barre.
Joyce, Henry J.,	B.M.,	2	Chicago, Ill.
Joyce, Richard Kerns,	L.F.,	2	Pittsburgh.
Kane, John T.,	B.M.,	2	Hastings-on-Hudson, N. Y.
Karabel, Joseph,	Tel.,	2	Philadelphia.
Kaseman, Harry C.,	Tel.,	2	Wheelerville.
Kaucher, George William,	B.M.,	3	Philadelphia.
Kauffman, Homer Benjamin,	R.C.,	2	Lebanon.
Kauffman, Robert Terry,	Tel.,	3	Chambersburg.

Kaufman, Leroy Franklin,	E.T.,	2	Tower City.
Kearney, Patrick F.,	B.M.,	2	Shamokin.
Keays, James F.,	B.M.,	2	Warrensburg, N.Y.
Keelan, James Michael,	E.T.,	2	South Fork.
Kehoe, John Francis,	Tel.,	1	Watertown, Wis.
Keighley, Theodore W.,	Tel.,	2	Hoboken.
Kellogg, Cecil Dell,	B.M.,	3	Ceres, N. Y.
Kellogg, Howard Schuyler,	E.T.,	2	Rochester, N. Y.
Kelly, Edward J.,	L.F.,	1	Cleveland, Ohio.
Kelly, John A.,	B.M.,	2	Plains.
Kelly, Oscar V.,	Tel.,	1	Milwaukee, Wis.
Kelser, Leo A.,	Car.,	2	Shamokin.
Kennedy, James J.,	Tel.,	2	Larksville.
Kennedy, Joseph Aloysius,	B.M.,	3	Pittston.
Kennedy, Walter Russell,	L.F.,	3	Philadelphia.
Kennet, Fred Garland,	E.T.,	1	Roanoke, Va.
Kenney, George R.,	B.M.,	1	Milboro Spring, Va.
Kenworthy, George Wilson,	L.F.,	3	Philadelphia.
Kerr, Oliver W.,	B.M.,	2	Philadelphia.
Kessels, Anthony Peter,	B.M.,	3	Sunbury.
Kessler, Bruno,	Car.,	2	Dunkirk, N. Y.
Kesty, Roston Lee,	B.M.,	3	Sunbury.
Kettleberger, William John,	B.M.,	3	Drexel Hill.
Kightlinger, Clifford V.,	R.C.,	2	Townville.
King, Clayton P.,	Tel.,	1	Cape Charles, Va.
King, John H.,	R.R.,	2	Punxsutawney.
Kirk, Edgar L.,	L.E.,	2	Harrisburg.
Kirk, John,	Con.,	2	New York, N. Y.
Kirk, Joseph James,	B.M.,	3	Harrisburg.
Kirkland, John Roy,	B.M.,	1	Richmond, Va.
Kirn, Edgar Lewis,	L.F.,	2	
Kiser, Oliver Andrew,	B.M.,	1	Mt. Cranford, Va.
Klaus, George Bonifacius,	B.M.,	3	Philadelphia.
*Klein, Philip,	Con.,	2	Wilkes-Barre.
Kline, Harold H.,	L.E.,	1	Williamsport.
Kline, Ira Miller,	L.F.,	3	Millersburg.
Klonowski, Daniel J.,		3	Pittsburgh.
Knablein, Leo John,	L.F.,	3	Erie.
Knaggs, Roland C.,	L.E.,	1	Detroit, Mich.
Knapp, George W.,	R.R.,	1	Norfolk, Va.

*Died August 23, 1918.

Knight, Edward Anthony,	R.C.,	2	Scranton.
Koehler, Charles William,	B.M.,	3	Philadelphia.
Kohler, Daniel E.,	Tel.,	2	Chambersburg.
Kominz, Alexander,		2	Rochester, N. Y.
Kopp, Charles F.,	Tel.,	2	Philadelphia.
Kossatz, August Carl,	B.M.,	3	Philadelphia.
Kramer, Willard,	L.E.,	1	Peru, Ind.
Krasley, Norman Elias,	Tel.,	3	Allentown.
Kratt, Elmer R.,	Tel.,	2	Pittsburgh.
Kraus, Frederick C.,	B.M.,	2	Pittsburgh.
Krause, James C.,	E.T.,	2	Pittsburgh.
Kreig, William,	Car.,	2	Plymouth.
Kress, Julius V.,	Car.,	2	Buffalo, N. Y.
Krewson, John H.,	Tel.,	1	Ocean View, Va.
Kuebler, Joseph C.,	E.T.,	1	Allentown.
Kues, William C.,	E.T.,	1	Roanoke, Va.
Kuhn, George Monroe,	B.M.,	3	Altoona.
Kuser, Paul Melvin,	E.T.,	2	Reading.
Lacher, Luther M.,	Tel.,	2	Leetsdale.
Lalley, Patrick Aloysius,	L.F.,	3	Scranton.
Lamb, John J.,	Tel.,	1	Ocean View, Va.
Lance, Lawrence R.,	L.E.,	1	St. Louis, Mo.
Landsman, Mortimer,	C.,	2	Brooklyn, N. Y.
Langan, Joseph Francis,	B.M.,	2	Dunmore.
Lapin, Daniel James,	B.M.,	2	Mays Landing, N.J.
Larsen, William Peter,	L.E.,	2	Perth Amboy, N.J.
Laughrey, Orran W.,	B.M.,	3	Scottdale.
Laverty, Frank Albert,	B.M.,	3	Darby.
Lawton, John Francis,	R.R.,	2	Syracuse, N. Y.
Layman, Manuel,	L.E.,	1	Fairmont, W. Va.
Leder, Sol,	E.T.,	2	New York, N. Y.
Lee, Saunders, P. M.,	L.F.,	1	Richmond, Va.
Leech, Glenn Wilmont,	B.M.,	3	Washington.
Leedom, Daniel M., jr.,	B.M.,	2	Philadelphia.
Leibfried, Edwin,	Tel.,	2	Philadelphia.
Leininger, Paul Raymond,	L.F.,	3	Reading.
Leitch, Edwin Gilbert,	B.M.,	1	Richmond, Va.
Lencer, Noah,	B.M.,	2	Philadelphia.
Leonard, Joseph Charles,		1	Norfolk, Va.
LeVan, Orville R.,	Tel.,	1	Grand Junction, Col.

Levy, Charles,	B.M.,	3	Philadelphia.
Lewis, Alfred H.,	B.M.,	2	Scranton.
Lewis, Preston,	E.T.,	2	Scranton.
Lindsey, Harry V.,	Tel.,	1	Cliff View, Va.
Lingle, Wesley J.,	Con.,	2	Lebanon.
Lion, Walter Anthony,	R.C.,	2	Philadelphia.
Lininger, Blair Watson,	Tel.,	3	Williamsburg.
Lischinsky, Morris,	B.M.,	2	Philadelphia.
Liston, Eugene Thomas,	E.T.,	2	Woodhaven, N. Y.
Lockwood, Raymond W.,	Tel.,	2	Wappingers Falls, N. Y.
Loeffler, Wendalin Frank,	L.E.,	2	Philadelphia.
Loftin, Grady A.,	R.C.,	1	Altavista, Va.
Loftus, John B.,	Tel.,	2	McKees Rocks.
Long, Curtis W.,	Tel.,	2	Reading.
Long, Edward D.,	Tel.,	2	Philadelphia.
Long, Joseph F.,	Tel.,	2	Pittston.
Loomis, Leon Eugene,	L.F.,	3	Athens.
Lord, Arthur C.,	B.M.,	2	Irvington, N. Y.
Lose, Lloyd L.,	Car.,	2	Philadelphia.
Lowe, Frederick,	Tel.,	2	Pittsburgh.
Lowe, Morris P.,	Tel.,	2	Philadelphia.
Lowery, William T.,	Tel.,	1	Fredericksburg, Va.
Lowry, John M.,	Tel.,	2	Buffalo, N. Y.
Lucado, Benjamin Thomas,	B.M.,	1	Roanoke, Va.
Lukauski, Wladislaw C.,	L.F.,	1	Chicago, Ill.
Lyle, Thurman F.,	L.E.,	1	Bridgeport, Ohio.
Lynch, Constant Aloysius,	L.F.,	3	Philadelphia.
Lynott, Robert J.,	Tel.,	2	Scranton.
Lyon, Robert Alexander,	B.M.,	3	Connellsville.
Lyons, Raymond L.,	Tel.,	2	Philadelphia.
McAndrews, Claver Joseph,	L.E.,	2	Carbondale.
McCabe, Louis Aloysius,	R.C.,	2	Philadelphia.
McCarron, Joseph C.,	L.E.,	1	Georgetown, Mich.
McCarthy, Joseph Lamar,	R.R.,	2	Oil City.
McCormick, Timothy Nelson,	R.C.,	2	Buffalo, N. Y.
McCracken, Guy Francis,	Tel.,	3	Claysville.
McCracken, James P.,	Tel.,	1	Elucia, Ind.
McCullough, Thomas James,	B.M.,	3	Philadelphia.
McCurdy, Mervyn Hepburn,	B.M.,	3	Philadelphia.

McCurdy, Paul Robert,	L.E.,	2	Osawatomie, Kan.
McElwee, Frank L.,	L.F.,	1	Covington, Va.
McElwee, Leo Joseph,	B.M.,	3	Philadelphia.
McGill, John,	L.E.,	2	Winona, Minn.
McGinn, Arthur Sebastian,	E.T.,	2	New York, N. Y.
McGough, James H.,	Tel.,	2	Utica, N. Y.
McGregor, Paul,	B.M.,	3	DuBois.
McGrother, Joseph Francis,	R.C.,	2	Philadelphia.
McGrorty, Edward V.,	Tel.,	2	Philadelphia.
McGuire, William James,	B.M.,	3	Inkerman.
McIntosh, Arthur Pruden,	L.E.,	2	Stuart, Va.
McIntyre, William B.,	B.M.,	2	Buffalo, N. Y.
McKnight, Thomas F.,	B.M.,	2	Philadelphia.
McLean, Frank C.,	Tel.,	2	Rochester, N, Y.
McLelland, Clarence R.,	R.R.,	1	Danville, Va.
McLeod, William C.,	L.E.,	1	Dalkeith, Ontario, Canada.
McNally, Henry P.,	Car.,	2	Philadelphia.
McNerney, William H.,	L.E.,	1	Salamanca, N. Y.
McNevin, John Raymond,	L.F.,	2	St. Paul, Minn.
McNiece, Harold,	R.R.,	2	Hastings-on-Hudson, N. Y.
McSwiggen, Joseph L.,	Tel.,	2	Pittsburgh.
Madara, Clarence Leroy,	B.M.,	3	Reading.
Madary, Tryon Oscar,	B.M.,	3	Reading.
Madison, Harry Deane,	E.T.,	2	Galeton.
Magee, Joseph Lee.	L.E.,	2	Yoakum, Tex.
Maguire, John Joseph,	B.M.,	3	Philadelphia.
Mahoney, John T.,	L.E.,	1	Cincinnati, O.
Maierhofer, Wilbert Carl,	E.T.,	2	Pittsburgh.
Maltz, David,	R.C.,	2	New York, N. Y.
Mann, James O.,	Tel.,	1	Lynchburg, Va.
Manbeck, Boyd,	Con.,	2	Harrisburg.
Mann, William Frederick,	B.M.,	3	Philadelphia.
Manning, Arthur E.,	Tel.,	1	Princeton, W. Va.
Mantz, William C.	B.M.,	2	Mt. Oliver.
Mapous, Amos F.,		2	Stoneboro.
Markle, Leroy Claire,	Tel.,	2	Lincoln Place.
Markley, Matthew Gray,	L.E.,	2	Philadelphia.
Martin, George Washington,	B.M.,	3	Harrisburg.
Martin, Michael W.,	E.T.,	1	South Bethlehem.

Mason, Frank Lewis,	L.E.,	2	Chicago.
Massaro, David G.,	Tel.,	2	New Castle.
Masters, Arthur E.,	Tel.,	1	Nanticoke.
Matheys, Jacob G.,	Tel.,	2	Boyertown.
Mattern, Ralph J.,	B.M.,	2	Reading.
Mattox, Walter G.,	Tel.,	3	McKeesport.
Maughan, John Alphonsus,	B.M.,	3	Pittston.
Maurer, Harry J.,	C.,	2	Harrisburg.
Maurice, Charles E.,	Tel.,	1	Richmond, Va.
Mawn, Thomas Robert,	L.E.,	1	Johnsonburg.
Mayo, William E.,	C.,	1	Lynchburg, Va.
Medary, Aaron Thomas,	B.M.,	3	Philadelphia.
Meinhold, Walter Fred,	L.E.,	2	Evansville, Ind.
Menefee, Lee Morton,	B.M.,	1	Rocky Mount, Va.
Menges, John George,	B.M.,	3	Hanover.
Merkel, Walter W.,	Tel.,	3	Reading.
Merrell, John O.,	B.M.,	2	Danville, Va.
Metzier, George C.,	B.M.,	3	Pittsburgh.
Meyers, Jacob,	B.M.,	3	Pittsburgh.
Michael, Frank,	B.M.,	2	Philadelphia.
Michaux, James M.,	E.T.,	1	Michaux, Va.
Middaugh, Jay Harold,	E.T.,	2	Pittsburgh.
Mikel, William Hilbert,	E.T.,	2	Williamsport.
Milhahn, William A.,	L.E.,	1	Dalton, O.
Miller, Jackson Stewart,	B.M.,	3	Plains.
Miller, James Lawrence,	R.C.,	2	Oil City.
Miller, Jesse Carl,	L.F.,	3	Rohrsburg.
Miller, Lewis Blair,	B.M.,	3	Sharon.
Miller, William Abia,	B.M.,	3	Philadelphia.
Milligan, Charles W.,	Tel.,	2	Fergusonville, N. Y.
Mitchell, James W.,	C.,	2	Sarver Station.
Mitsmenn, Clarence Edward,	L.E.,	2	Providence, R. I.
Moberg, Harry V.,	Con.,	2	Clearfield.
Mologne, Frank Edmund,	Tel.,	3	FitzHenry.
Moomaw, Joseph F.,	L.F.,	1	Roanoke, Va.
Moore, George Washington,	Tel.,	3	Philadelphia.
Moore, Joseph Michael,	B.M.,	3	Philadelphia.
Moran, Francis Joseph,	R.C.,	2	Scranton.
Moran, Herma L.,	E.T.,	1	Enfield, Va.
Moran, Thomas Joseph,	L.E.,	2	Plains.

Morelen, James C.,	C.,	1	Norfolk, Va.
Morgan, Edmund F.,	B.M.,	3	Shamokin.
Morpeth, Embelton Stewart,	L.E.,	2	Wilkes-Barre.
Morrell, John O.,	B.M.,	3	
Morris, Clyde Eugene,	B.M.,	1	Portsmouth, Va.
Morris, Roland,	B.M.,	1	Rocky Mount, N. C.
Morris, Russell,	B.M.,	1	Portsmouth, Va.
Morris, Thomas G.,	Tel.,	1	Racine, Wis.
Morrison, Angus,	L.E.,	1	St. Charles, Mich.
Morrisey, John L.,	B.M.,	2	Plymouth.
Morrow, Raymond Earl,	B.M.,	3	Scottdale.
Morton, Robert G.,	Tel.,	1	Phoenix, Va.
Mory, George Abner,	E.T.,	2	Allentown.
Motz, Charley Calvin,	L.E.,	2	Berthoud, Col.
Mount, Thomas George,	L.F.,	2	Red Bank, N. J.
Moyer, Raymond J.,	Tel.,	2	Lebanon.
Moyer, Howard Wayne,	B.M.,	3	Philadelphia.
Mulholland, Francis Joseph,	B.M.,	3	Philadelphia.
Mull, John K.,	L.E.,	1	Jeanette.
Mulligan, Vincent M.,	E.T.,	2	Bethlehem.
Mullin, Charles E., jr.,	Tel.,	2	Mt. Pleasant.
Munday, Earl,	L.E.,	2	Minneapolis, Minn.
Mundkowski, Otto,	L.F.,	3	Nanticoke.
Munzer, Frederick,	Con.,	2	Philadelphia.
Murdock, Charles E.,	E.T.,	1	Richmond, Va.
Murnamer, William Robert,	L.F.,	2	Cherry Valley.
Murphy, Edward L.,	B.M.,	1	Washington, D. C.
Murphy, Thomas F.,	Car.,	2	Philadelphia.
Murphy, William James,	L.F.,	3	Philadelphia.
Muse, Roy,	Car.,	2	Irwin.
Musser, Lewis Winfield,	R.C.,	2	York.
Myers, Charles H.,	Tel.,	1	Danville, Va.
Myers, Chester Vance,	B.M.,	3	Siddonsburg.
Myers, George G.,	Tel.,	1	Covington, Ky.
Naugle, Charles William,	B.M.,	3	Nanticoke.
Neary, James T.,	B.M.,	2	Philadelphia.
Neill, Fred Alexander,	L.F.,	3	Clarion.
Nelan, Clark Mills,	B.M.,	3	Dunn's Station.
Nelson, Clemens J.,	L.F.,	1	Chicago, Ill.
Nelson, Jacob,	C.,	2	Philadelphia.

Nesbitt, Frederick C.,	C.,	2	Plymouth.
Ness, Levy Lawrence,	B.M.,	3	York.
Nestel, William Charles,	B.M.,	3	Philadelphia.
Neu, Louis, Jr.,	Con.,	2	Buffalo, N. Y.
Newell, Frank A.,	B.M.,	2	Poughkeepsie, N.Y.
Newell, William Shippen,	Tel.,	3	Philadelphia.
Newton, James C.,	Tel.,	2	Philadelphia.
Newton, William H.,	B.M.,	2	Philadelphia.
Niblett, Lloyd Franklin,	B.M.,	1	Dendron, Va.
Nichols, Elmer,	L.F.,	2	St. Louis, Mo.
Nickler, Benjamin,	R.R.,	2	Emporium.
Niva, Walter Enah,	L.E.,	2	Fruit Dale, S. D.
Noel, Ray Emerson,	E.T.,	2	Ligonier.
Noel, William D.,	L.E.,	1	Toledo, Ohio.
Nolan, John L.,	Con.,	2	Edward, N. Y.
Nolan, Martin E.,	B.M.,	2	Scranton.
Noll, Ernest Frederick,	B.M.,	3	Philadelphia.
Norman, Frederick,	C.,	2	Pittsburgh.
Norris, Charles F.,	L.E.,	1	Cleveland, Ohio.
North, William,	Tel.,	1	Appomatox, Va.
Norton, Daniel Joseph,	L.E.,	2	Providence, R. I.
Novinger, Charles H.,	B.M.,	2	Harrisburg.
Nowlin, Warren S.,	Tel.,	1	Lynchburg, Va.
Nudge, John,	Tel.,	2	Throop.
O'Brien, Cornelius Charles,	B.M.,	3	Shamokin.
O'Brien, George Thomas,	B.M.,	3	Philadelphia.
O'Brien, John P.,	L.F.,	1	Roanoke, Va.
O'Brien, William L.,	B.M.,	2	Scranton.
Ochman, Chaim,	C.,	2	Philadelphia.
Ochsner, Albert,	L.E.,	2	Providence, R. I.
O'Connor, Marcellus A.,	B.M.,	2	Philadelphia.
O'Dea, Richard M.,	Tel.,	2	Wilkes-Barre.
Oden, Hartley,	B.M.,	3	McKeesport.
O'Donnell, Aloysius Patrick,	B.M.,	3	Parsons.
O'Donnell, John Ignatius,	B.M.,	3	Philadelphia.
Offenbacker, Martin A.,	B.M.,	2	Mechanicsville, N. Y.
Ogden, Carlton F.,	Tel.,	2	Waynesburg.
O'Hara, James,	Con.,	2	Hastings-on-Hudson, N. Y.
O'Hare, James Thomas,	B.M.,	3	Jeannette.

O'Hare, Robert Alfred,	B.M.,	3	Jeannette.
Oldsen, Benjamin H.,	E.T.,	1	Bethlehem.
Olmsted, Burrell Enslin,	L.F.,	3	Milford.
Ord, Ralph,	B.M.,	3	McKeesport.
Osler, Frank,	L.F.,	1	Rainey River, Ontario, Canada.
Osmond, James Leonard,	B.M.,	3	Philadelphia.
Oswald, Joseph F.,	Tel.,	2	Scranton.
*Ott, Harry Keller,	Tel.,	3	Bellefonte.
Ottaway, Ernest W.,	E.T.,	2	Syracuse, N. Y.
Owen, Charles H.,	Tel.,	1	Lynchburg, Va.
Owen, Frank Leftwich,	B.M.,	1	Lynchburg, Va.
Page, Elmer E.,	Car.,	2	Binghamton, N. Y.
Page, Harry T.,	R.R.,	1	Hot Springs, Va.
Pahl, Otto Ludwig,	R.C.,	2	Philadelphia.
Palmer, Ralph F.,	L.E.,	1	Scranton.
Palmer, Thomas Seddon,	B.M.,	1	Erwin, Tenn.
Parker, John Lee,	B.M.,	1	Mount Landing, Va.
Parkinson, Burton Owen,	L.F.,	2	Anita, Iowa.
Parks, Nelson Ceibert,	L.F.,	3	Grafton.
Patton, Clayton L.,	Tel.,	1	Lynchburg, Va.
Paul, Thomas V.,	Tel.,	2	Philadelphia.
Payne, Charles F.,	Tel.,	1	Gordonsville, Va.
Pearl, Henry J.,	Tel.,	2	Philadelphia.
Pease, Norris Dunham,	R.C.,	2	Plainville, Conn.
Peery, Andrew M.,	R.R.,	1	North Tazewell, Va.
Pelliccio, Ernest A.,	Tel.,	2	Philadelphia.
Pendleton, Robert W.,	Tel.,	1	Gate City, Va.
Penn, Simon,	B.M.,	3	Connellsville.
Pennell, Frank E.,	Tel.,	1	Richmond, Va.
Penny, Lawrence A.,	L.E.,	1	Detroit, Mich.
Penny, Roy W.,	L.E.,	1	Minneapolis, Minn.
Perrow, Moss H.,	Tel.,	1	Lynchburg, Va.
Peterman, Elmer Myers,	B.M.,	3	Philadelphia.
Pheasant, Oscar Warren,	R.R.,	2	McClure.
Phillips, David D.,	Tel.,	3	Wanamie.
Phillips, Howard E.,	Tel.,	2	Allentown.
Philpott, Homer H.,	Tel.,	1	Roanoke, Va.
Pierce, Roy Norman,	B.M.,	3	Rathmel.

*Died October 25, 1918.

Pierce, William Henry,	L.E.,	2	Woonsocket, R. I.
Piercy, George E.,	Tel.,	2	Ebensburg.
Pinyak, Joseph S.,	B.M.,	2	Scranton.
Pipher, George C.,	Tel.,	2	Stroudsburg.
Pipkin, Willis Irie,	B.M.,	1	Norfolk, Va.
Pitt, Laurance Ralph,	B.M.,	3	Spring Creek.
Pittman, Harold R.,	Tel.,	2	Kingston.
Pitts, George R.,	Tel.,	2	Philadelphia.
Plank, Walter J.,	Tel.,	2	Irwin.
Plotts, George Benjamin,	E.T.,	2	Williamsport.
Poelaert, Louis,	L.E.,	2	Jackson, Minn.
Poladian, Jacob Harrytune,	R.R.,	2	Troy, N. Y.
Polito, James Joseph,	B.M.,	3	Emporium.
Porter, Meredith Frank,	R.C.,	2	Moylan.
Poulson, Clifford Ellis,	L.F.,	2	Scio, Ohio.
Powell, Austin L.,	E.T.,	1	Norfolk, Va.
Powell, Robert J.,	Tel.,	1	Norfolk, Va.
Powers, Curtis H.,	Tel.,	2	Pen Yan, N. Y.
Powers, Edward Joseph,	L.E.,	2	Plymouth.
Prebish, John,	L.F.,	3	Nanticoke.
Priddy, Newton,	R.C.,	1	Ashland, Va.
Purcell, Joseph A.,	R.C.,	1	Richmond, Va.
Putnam, Guy D.,	E.T.,	1	Front Royal, Va.
Quinn, John Joseph,	B.M.,	3	Reading.
Rackler, Samuel,	Con.,	2	New York, N. Y.
Rago, Frank Amerigo,	R.C.,	2	Syracuse, N. Y.
Ramage, William F.,	Tel.,	2	Wilmerding.
Rapp, Scott N.,	Tel.,	2	Reading.
Rayman, Abe,	C.,	2	New York, N. Y.
Rebert, Nelson Taylor,	B.M.,	3	Stowe.
Reed, Charles P.,		2	Corsica.
Reed, Daniel A.,	Car.,	2	Shamokin.
Reed, Harry Daniel,	L.F.,	3	Shamokin.
Reed, John Ray,	B.M.,	1	Decatur, Va.
Regan, Thomas Patrick,	R.C.,	2	Scranton.
Rehrer, Charles Bertram,	Tel.,	3	Shamokin.
Reichart, Albert J.,	B.M.,	2	Rochester, N. Y.
Reinert, William Aloysius,	Tel.,	3	Wilkes-Barre.
Renfer, Howard William,	L.F.,	3	Pittston.
Renn, Leroy Bruce,	R.R.,	2	Montandon.
Rhoades, Frank William,	B.M.,	3	Philadelphia.

Rickrode, Ralph Obadia,	L.F.,	3	Hanover.
Riebe, Leonard William,	R.R.,	2	Wellsboro.
Rieling, Edwin P.,	Tel.,	2	Philadelphia.
Rife, John A.,	Tel.,	1	Naperville, Ill.
Ring, Harry,	E.T.,	1	Pulaski, Va.
Ritter, Elmer E.,	B.M.,	2	Reading.
Roadarmel, Clyde J.,	Tel.,	2	Catawissa.
Roberts, George A.,	B.M.,	2	New Hartford, N. Y.
Roberts, Charles Henry,	L.F.,	2	Pittsburgh.
Roberts, John William,	L.E.,	2	Stockton, Cal.
Robertson, Archibald Earl,	E.T.,	2	Philadelphia.
Robinson, Joseph A.,	Con.,	2	Pittsburgh.
Roche, Edmund A.,	Tel.,	2	Germantown.
Roder, Ward Buckley,	R.C.,	2	Lincoln Park, N. Y.
Rodgers, Forrest Paul,	B.M.,	3	Johnstown.
Roe, Walter C.,	C.,	2	Hudson, N. Y.
Roeder, Raymond S.,	Tel.,	2	Perkasie.
Roehrig, Oscar H.,	Con.,	2	Allegheny, Pittsburgh.
Rogers, Robert Alvin,	L.E.,	2	Covington, La.
Rogers, Thomas Weldon,	B.M.,	3	Sunbury.
Rohland, William R.,	L.F.,	3	Middleburg.
Rohzer, David Chester,	E.T.,	2	
Rolf, William L.,	Con.,	2	Buffalo, N. Y.
Root, Charles Thomas,	B.M.,	1	Philadelphia.
*Rosbach, Elmer P.,	L.F.,	3	Forksville.
Rose, Rosser W.,	E.T.,	1	Norfolk, Va.
Rosenburg, Martin,		2	New York, N. Y.
Rosengrant, Robert,	Con.,	2	Plains.
Ross, Cleon James,	B.M.,	3	Franklin.
Ross, Oliver,	L.E.,	2	Providence, R. I.
Ross, Raymond Albert,	B.M.,	3	Washington.
Roth, Stanley,	L.E.,	2	Allentown.
Rothwell, Robert W.,	Tel.,	1	Charlottesville, Va.
Rountree, Amos L.,	Tel.,	1	Hampton, Va.
Routh, John Robert,	B.M.,	3	Philadelphia.
Rouzer, David C.,	E.T.,	2	Altoona.
Rubin, Herman,	B.M.,	2	New York, N. Y.
Runion, Robert P.,	Tel.,	1	Draper, Va.
Russell, Elmer Street,	R.C.,	2	Philadelphia.

*Died November 14, 1918.

Ruth, Arthur S.,	Tel.,	1	Gate City, Va.
Ryan, David F.,	C.,	2	Dobbs Ferry, N. Y.
Ryan, William J.,	Con.,	2	New York, N. Y.
Sander, Harold L.,	Tel.,	2	Rochester, N. Y.
Sassaman, George Washington,	R.C.,	2	Reading.
Sassaman, James McKinley,	B.M.,	3	Penns Creek.
Sather, Oge B.,	L.E.,	1	Minneapolis, Minn.
Satterfield, Westley Clyde,	E.T.,	2	Altoona.
Saul, Stewart Conway,	B.M.,	3	Schuylkill Haven.
Saunders, Henry Russell,	B.M.,	1	Portsmouth, Va.
Schaff, Bernard W.,	Tel.,	1	Richmond, Va.
Schappert, Michael K.,	B.M.,	2	Wilkes-Barre.
Schauble, Frederick F.,	L.F.,	2	Buffalo, N. Y.
Schecter, Frank,	Tel.,	2	Philadelphia.
Schott, Edward Lewis,	L.F.,	2	Pittsburgh.
Schroder, John Arthur,	L.F.,	1	St. Bonifacius, Minn.
Schubert, Frederick V.,	Car.,	2	Philadelphia.
Schuler, Victor H.,	Tel.,	2	Shamokin.
Schultz, Roy J.,		3	Dunmore.
Scott, John Walter,	E.T.,	2	Bradford.
Scotti, Martin R.,	E.T.,	1	Taylor Springs, Ill.
Seibert, Harry C.,	E.T.,	1	Norfolk, Va.
Seidel, Fred,	L.E.,	2	San Bernardino, Cal.
Selender, Harry I.,	B.M.,	2	Wilkes-Barre.
Shaefer, Lawrence H.,	Tel.,	2	Scranton.
Shafer, Scott Herbert,	B.M.,	3	Sunbury.
Shaffer, Harry Franklin,	L.F.,	3	York Haven.
Shamp, Cloyd Samuel,	B.M.,	3	Altoona.
Sharrow, Clayton H.,	Car.,	2	Hughesville.
Shatz, Ben,	R.R.,	2	Brooklyn, N. Y.
Sheahan, Henry Daniel,	L.F.,	2	Chicago, Ill.
Shepard, Walter Owen,	L.E.,	2	Council Bluffs, Iowa.
Sherwood, Robert F.,	R.C.,	2	Hornell, N. Y.
Shetter, Ira D.,	Tel.,	2	Chambersburg.
Shewan, Stanley,	L.F.,	3	Dorranceton.
Shoff, Gray G.,	Tel.,	2	Madera.
Short, Harry,	E.T.,	2	Philadelphia.
Shorts, Richard Parker,	Tel.,	3	Franklin.

Siegfried, William Aloysius,	R.C.,	2	Philadelphia.
Sikorski, Anthony Henry,	Tel.,	3	Scranton.
Simone, Alexander, jr.,	B.M.,	2	Philadelphia.
Simone, William P.,	B.M.,	2	Philadelphia.
Simons, Robert,	E.T.,	2	Pottsville.
Singleton, Carey Bryan,	L.F.,	2	Fisherville, Ky.
Sinnott, John J.,	Car.,	2	Philadelphia.
Sisk, Wood Walker,	B.M.,	1	Sperryville, Va.
Skibbe, Charles Lewis,	B.M.,	3	Norristown.
Skruppy, Hugh,	L.F.,	1	Staples, Minn.
Slade, Robert James,	B.M.,	1	Dendron, Va.
Slates, Benjamin F.,		2	Huntington.
Slezeski, Stephen S.,	Con.,	2	Kingston, N. Y.
Sloggett, Albert John,	E.T.,	2	Pen Argyl.
Small, James Aloysius, jr.,	L.F.,	3	Connellsville.
Smart, George W.,	Tel.,	2	Lincoln Place.
Smith, Harry,	R.C.,	2	Philadelphia.
Smith, Henry Heilman,	B.M.,	3	Franklin.
Smith, Hugh J.,	L.F.,	2	
Smith, Leland E.,		2	Wilkes-Barre.
Smith, Leo R.,	L.F.,	3	Florin.
Smith, Nelson,	Tel.,	3	Kennerdell.
Smith, Russell James,	L.E.,	2	Easton.
Smith, Russell J.,	L.F.,	3	Wellsville.
Smith, Thomas Olen,	L.F.,	3	Sharpsville.
Smith, William J.,	Car.,	2	Philadelphia.
Smyers, Wilbur C.,	Car.,	2	Rockhill Furnace.
Snell, Harry J.,	E.T.,	1	Sayre.
Snow, Arthur Howland,	L.F.,	3	Philadelphia.
Snyder, Allen F.,	Con.,	2	Reading.
Snyder, Paul,	R.C.,	2	Reading.
Solberg, Martin Christopher,	L.E.,	2	Ferryville, Wis.
Somers, Lee A.,	Tel.,	1	Fremont, Mich.
Soule, Grenville C.,	B.M.,	2	Clay, N. Y.
Sours, John A.,	R.R.,	1	Keen, Va.
Sowa, William H.,	B.M.,	3	Reading.
Sowers, Foster Flegal,	E.T.,	2	Harrisburg.
Spader, Frank Lee,	R.C.,	2	Pittsburgh.
Spang, Charles Edward,	B.M.,	3	Philadelphia.
Spangler, Charles B.,	L.F.,	1	Floyd, Va.
Spangler, William Henry,	B.M.,	3	York.

Spath, William Harry,	B.M.,	3	Philadelphia.
Speakman, Leslie P.,		2	Westland.
Speight, Carlton,	L.F.,	1	Port Norfolk, Va.
Spencer, John F., jr.,	E.T.,	1	Bedford, Va.
Spencer, Joseph Reynolds,	R.C.,	2	Erie.
Sperling, William,	B.M.,	2	New York, N. Y.
Spillane, Thomas J.,	Car.,	2	Archbald.
Spindler, Henry George,	B.M.,	3	Rochester, N. Y.
Spitzer, Charles Otterson,	L.F.,	2	Landing, N. J.
Spraker, Floyd G.,	Tel.,	1	Cripple Creek, Va.
Springman, Ralph Augustus,	L.F.,	3	Freeburg.
Spry, William J.,	Tel.,	3	Bangor.
Stadler, Edward George,	L.E.,	2	Denver, Col.
Stahl, William Herman,	B.M.,	3	Philadelphia.
Stamm, Henry Lawrence,	E.T.,	2	Harrisburg.
Stand, Murray W.,	Tel.,	2	New York, N. Y.
Stebelton, Lloyd Beecher,	L.E.,	2	Union, Tenn.
Steers, Andrew Young,	Tel.,	3	Bethlehem.
Stehle, John Henry,	E.T.,	2	Altoona.
Stehman, Clarence,	B.M.,	3	Columbia.
Stein, Harry,	L.F.,	2	
Steinhilber, William J.,	E.T.,	1	Norfolk, Va.
Stellmach, Thomas J.,	B.M.,	2	Philadelphia.
Stenglein, Elmer Maurice,	R.C.,	2	Philadelphia.
Sternberg, Victor,	L.E.,	1	New York, N. Y.
Stevens, Clarkson Gray,	Tel.,	3	Carlisle.
Stillwagon, Benjamin Bonbright,	R.C.,	2	Philadelphia.
Stinson, John M.,	B.M.,	2	Dobbs Ferry, N. Y.
Stolle, Louis S.,	Tel.,	1	Kalamazoo, Mich.
Stoltenburg, George A.,	B.M.,	3	Oil City.
Stone, James M., Jr.,	Tel.,	1	Ashland, Va.
Straub, Robert B.,	Con.,	2	Lebanon.
Strickland, Joseph Robinson,	R.C.,	2	Shamokin.
Sullivan, Charles Francis,	L.E.,	2	Dorchester, Mass.
Sullivan, Edward M.,	L.F.,	2	
Summers, James Dick King,	L.E.,	1	Stony Point, N. C.
Swanson, Carl Wilhelm,	R.R.,	2	Falls Creek.
Swanson, Edwin Oscar,	B.M.,	3	McKeesport.
Swanson, Elmer August,	B.M.,	3	McKeesport.
Sweetser, Harvey A.,	Tel.,	1	Brockton, Mass.
Swetland, Howard Smith,	B.M.,	3	Mills.

Taedter, Fred Charles,	L.E.,	2	Hastings, Neb.
Talbott, Arthur V.,	Tel.,	1	Pinners Point, Va.
Tanenbaum, Harry,	L.F.,	2	Philadelphia.
Tarrall, Henry A.,	E.T.,	1	Norfolk, Va.
Tate, Ralph Wade,	B.M.,	3	Duncanville.
Tatem, James Albert,	E.T.,	1	Norfolk, Va.
Taylor, Daniel C.,	Tel.,	1	Lynchburg, Va.
Taylor, George,	R.R.,	2	Oakdale.
Taylor, James Robert,	B.M.,	3	Tyrone.
Taylor, Ralph Sherman,	Tel.,	3	Wyalusing.
Taylor, Robert Burns,	B.M.,	3	Wilkes-Barre.
Telesk, Joseph Edmund,	B.M.,	3	Dunmore.
Teller, Robert Mc.,	L.E.,	1	Coraopolis.
Tennyson, Peter,	Tel.,	1	Nanticoke.
Thomas, Curry,	R.C.,	1	Cape Charles, Va.
Thomas, George J.,	B.M.,	3	Pittsburgh.
Thomas, R. S.,	Tel.,	2	Brisbin.
Thompson, James Martin,	B.M.,	3	Philadelphia.
Thompson, Roy Everette,	Tel.,	1	Carthage, Va.
Throne, Arthur Edward,	Tel.,	3	Erie.
Thurin, Theodore B.,	L.E.,	1	Sandstone, Minn.
Tignor, Daniel Grover,	B.M.,	1	Richmond, Va.
Tilley, Edward M.,	E.T.,	1	Roanoke, Va.
Tingstad, Gordon Edward,	L.E.,	2	Virginia, Minn.
Titlow, Frederick E.,	Tel.,	2	Reading.
Tobias, William Herman,	R.C.,	2	Philadelphia.
Tribolet, George A.,	L.E.,	1	Donaldson, Ind.
Troxell, Ralph H.,	Tel.,	2	Shamokin.
*Truax, George H.,	L.F.,	3	Needmore.
Tucker, Howard O.,	R.R.,	1	Blackstone, Va.
Tulley, Harry,	B.M.,	3	Connellsville.
Turner, Leonard J.,	Tel.,	1	Roanoke, Va.
Turner, Stuart T.,	Tel.,	2	Cornwells.
Tysor, Hugh Alton,	Con.,	1	Richmond, Va.
Vahner, Joseph Arthur,	B.M.,	3	Scottdale.
Valduga, Rudolph,	R.R.,	2	Morgan.
Vansice, Abram Jacobs,	E.T.,	2	Rochester, N. Y.
VanValkenburg, Robert R.,	B.M.,	2	Batavia, N. Y.
VanZandt, James Louis,	B.M.,	3	Lewistown.
Vetter, Clinton R.,	Tel.,	2	Scranton.
Vogel, Charles A.,	Tel.,	2	Glendale, N. Y.

*Died November 4, 1918.

Voit, Frank A.,	Con.,	2	Millvale.
VonBergen, Arthur L.,	L.E.,	1	Chicago, Ill.
Walch, Charles T.,	B.M.,	2	New York, N. Y.
Walker, Henry Otis,	L.E.,	2	Wichita, Kan.
Walker, Robert H.,	E.T.,	1	Stevensville.
Walsh, Charles Miller, jr.,	R.R.,	1	Petersburg, Va.
Walter, Henry R.,	Tel.,	1	Amissville, Va.
Walter, Harry Theodore,	L.F.,	3	Osterhout.
Walter, Willard E.,	Car.,	2	West Milton.
Waltz, Charles Garman,	L.F.,	3	Harrisburg.
Ward, Robert K.,	Tel.,	1	Rural Retreat, Va.
Warren, Otto Frank,	L.E.,	1	Sumner, Ill.
Wasley, John Richard,	B.M.,	3	Wilkes-Barre.
Watkins, Joseph S.,	E.T.,	1	Troutville.
Webber, Arthur H.,	B.M.,	2	Duquesne.
Weber, John James,	L.F.,	2	Brooklyn, N. Y.
Webster, Percy Raymond,	L.F.,	2	Cundy's Harbor, Me.
Weeter, Edwin T.,	B.M.,	2	Knox.
Weick, Joseph J.,	B.M.,	2	Philadelphia.
Weidenhammer, Caleb W.,	Tel.,	2	Reading.
Weinzettle, John P.,	Car.,	2	Millvale.
Weiss, David,	Tel.,	2	Philadelphia.
Weiss, Harry,	Tel.,	2	Philadelphia.
Welch, Perry,	L.F.,	2	Elwood, Ind.
Wells, Cecil E., jr.,	Tel.,	1	Petersburg, Va.
Wentzel, Paul Martin,	E.T.,	2	Reading.
Weslosky, John,	B.M.,	3	Excelsior.
Wessel, George Frank,	L.F.,	2	Beardstown, Ill.
West, John Joseph,	L.F.,	2	Trenton, N. J.
West, William L.,	Tel.,	1	Bacon's Castle, Va.
Westman, Carl Gust,	L.E.,	2	Pipin, Wis.
Whalen, John W.,	Tel.,	2	Batavia, N. Y.
Whitehurst, Obie Martin,	B.M.,	1	Norfolk, Va.
Whitehurst, Richard T.,	Tel.,	1	Portsmouth, Va.
Whitfield, Thomas Preston,	B.M.,	1	Hurdle's Mill, N. C.
Whitman, Clifford E.,	C.,	2	Reading.
Whitten, Oliver Eugene,	B.M.,	3	Oil City.
Whitton, John B.,	Tel.,	1	Alexandria, Va.
Wickham, Charles Gideon,	L.F.,	3	Hudson.

Wilcox, Frank Raymond,	R.C.,	2	Williamsport.
Wilkins, James Arthur,	B.M.,	1	Portsmouth, Va.
Wilkinson, George C.,	R.C.,	1	Petersburg, Va.
Williams, Al,	B.M.,	1	Danville, Va.
Williams, Clarence L.,	Tel.,	1	Blanchard, Okla.
Williams, James Edward,	B.M.,	1	Richmond, Va.
Williams, Max Hobert,	Tel.,	3	Dunmore.
Williams, Samuel S.,	E.T.,	1	Leadville, Col.
Williamson, Henry A.,	Tel.,	1	Chase City, Va.
Willis, John E.,	B.M.,	2	Banning.
Willison, Harvey Marcus,	L.F.,	2	East Brady.
Wilson, Dugald Earl,	L.F.,	2	Altoona.
Wilson, Samuel Scott,	R.R.,	2	Strattenville.
Wilson, Walter H.,	E.T.,	1	Terry's Fork, Va.
Wimmer, Ambrose M.,	L.F.,	3	Perkasie.
Winning, Edward E.,	L.E.,	1	Orrville, Ohio.
Wise, Albert,	B.M.,	2	Pittsburgh.
*Wisnowski, Benjamin V.,	B.M.,	3	Scranton.
Withrow, Charles Archibald,	B.M.,	1	Millboro, Va.
Witt, Harry N.,	E.T.,	1	Richmond, Va.
Woerner, John,	R.R.,	2	Union Hill, N. J.
Wolfe, David,	R.C.,	2	Wilkes-Barre.
Wolpert, James P.,	B.M.,	2	Philadelphia.
Wood, Daniel Henry,	L.E.,	1	Pittsburgh.
Woodley, John Lawrence,	B.M.,	1	Suffolk, Va.
Wrenn, Joseph Aubrey,	B.M.,	1	Danville, Va.
Wright, Donald Benjamin,	B.M.,	3	Harrisburg.
Wright, Howard Engle,	E.T.,	2	Philadelphia.
Wulfecamp, Harry,	B.M.,	2	Pittsburgh.
Wyatt, Elmer Lee,	L.E.,	2	Gardnerville, Nev.
Wynacht, James,	L.F.,	2	St. Paul, Minn.
**Yahner, Joseph A.,	B.M.,	3	Scottdale.
Yeager, William H., jr.,	B.M.,	2	Philadelphia.
Yedinsky, Emanuel M.,	Tel.,	2	Pottsville.
Yeslevitz, Frank N.,		2	Philadelphia.
Yingst, William Paul,	E.T.,	2	Lebanon.
York, Fred L.,	Tel.,	2	East Worcester, N. Y.
Youdovich, Max,		2	New York, N. Y.

*Died October 27, 1918.
**Died December 3, 1918.

Young, John,	B.M.,	3	Philadelphia.
Yungel, Albert Herman,	R.R.,	2	Harrisburg.
Zampogna, Joseph,	R.R.,	2	Johnsonburg.
Zeider, Franklin A.,	Tel.,	2	Richfield.
Zimmerman, David,	Tel.,	2	Scranton.
Zimmerman, Frank Lewis,	B.M.,	3	York.
Zitzman, Frank A.,	B.M.,	2	Pittsburgh.
*Zuendel, Walter H.,	B.M.,	3	Philadelphia.

*Died November 30, 1918.

Summary of Vocational Students

	1st Group May 15 to July 15 approximately	2nd Group July 15 to Sept. 15 approximately	3d Group Sept. 15 to Nov. 15 approximately	Total
Battery Mechanics	59	87	167	313
Carpentry		24		24
Concrete Work	4	32		36
Cooking	8	25		33
Electrical Trades	39	53		92
Locomotive Engineering.	54	76		130
Locomotive Firing	23	37	45	105
Railroad Track Work ...	17	25		42
Road Construction	14	52		66
Telegraphy	115	139	42	296
Unassigned	1	11	2	14
	334	561	256	1151

SUMMARY OF STUDENTS BY CLASSES AND COURSES

	* Graduates	Seniors	Juniors	Sophomores	Freshmen	Specials	Summer School Students	Totals
Arts & Science	28	15	18	33	104	4	1	203
Civil Eng.....	5	8	27	33	56		1	130
Mech. Eng.....	1	19	29	25	63			137
Mining Eng....	3	11	9	17	34	3		77
Metal. Eng.....	9	1	5	6	12	1		34
Electromet.....	2	3	11	8	6		1	31
Electric. Eng...	1	4	18	22	41	1	3	90
Chemistry.....	7	1	1	3	4	1	2	19
Chem. Eng.....	2	13	26	43	63	1	1	150
Naval Eng.....				4	27			31
Totals.....	58	75	144	194	410	11	9	901

*Graduate students are listed in the department in which they are taking their major subject.

SUMMARY OF STUDENTS BY STATES

Massachusetts	13
Connecticut	27
Rhode Island	3
New York	66
New Jersey	126
Pennsylvania	513
Delaware	3
Maryland	36
District of Columbia	34
Virginia	5
West Virginia	2
North Carolina	2
South Carolina	2
Ohio	16
Indiana	1
Illinois	7
Michigan	1
Wisconsin	1
Minnesota	1
Kentucky	3
Missouri	1
Louisiana	1
Tennessee	1
Alabama	1
Oklahoma	1
California	2
Porto Rico	2
Mexico	5
Honduras	1
Colombia	2
Brazil	1
Ecuador	1
Venezuela	1
Russia	1
Siam	1
Japan	2
China	13
Dutch East Indies	2
	901

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